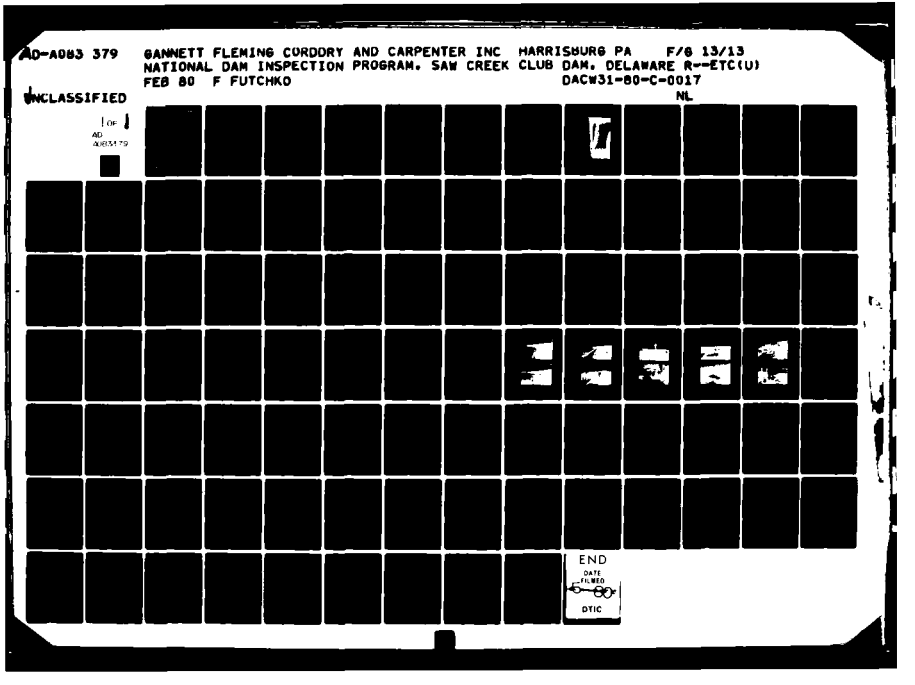
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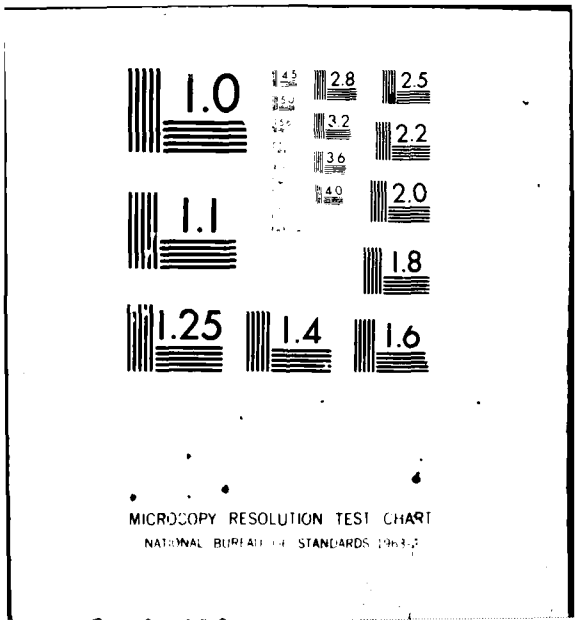
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DELAWARE RIVER BASIN
SAW CREEK, PIKE COUNTY

PENNSYLVANIA

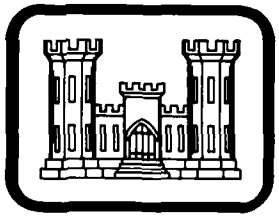
LEVEL II

SAW CREEK CLUB DAM

NDI ID NO. PA-00764
DER ID NO. 52-7

SAW CREEK CLUB, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

FEBRUARY 1980

(16) National Dam Inspection Program.

DELAWARE RIVER BASIN,

SAW CREEK, PIKE COUNTY,

PENNSYLVANIA

SAW CREEK CLUB DAM

(NDI ID No. PA-00764,
DER ID No. 52-7)

SAW CREEK CLUB, INC.

PHASE I INSPECTION REPORT,

NATIONAL DAM INSPECTION PROGRAM

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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(19) Prcw 31-80-C-0017

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) FEBRUARY 1980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

DELAWARE RIVER BASIN

SAW CREEK, PIKE COUNTY

PENNSYLVANIA

SAW CREEK CLUB DAM

NDI ID No. PA-00764
DER ID No. 52-7

SAW CREEK CLUB, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1980

CONTENTS

APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

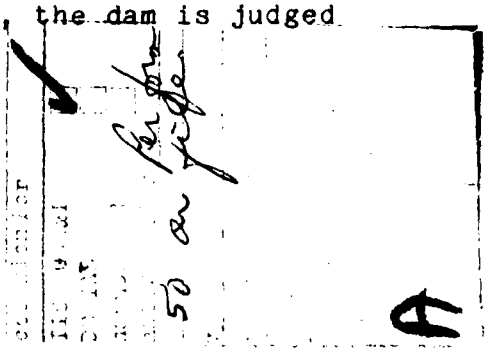
BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Saw Creek Club Dam NDI ID No. PA-00764 DER ID No. 52-7
Size:	Small (14 feet high; 353 acre-ft - Existing Conditions).
Hazard Classification:	High
Owner:	Saw Creek Club, Inc. Robert Fish, Steward P.O. Box 209 Marshalls Creek, Pa. 18335
State Located:	Pennsylvania
County Located:	Pike
Stream:	Saw Creek
Date of Inspection:	15 November 1979

According to criteria established for these studies, the spillway capacity of Saw Creek Club Dam is rated as seriously inadequate and the dam is classified as unsafe, non-emergency. The existing spillway will pass only 9 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. Based on the criteria and the downstream conditions, the PMF is the Spillway Design Flood for the dam. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass only about 22 percent of the PMF, and it would still be rated as seriously inadequate. Failure of the dam would cause an increased hazard for loss of life downstream. As a whole, the dam is judged to be in fair condition.



No stability problems were evident for the embankment at the time of the visual inspection, but a potential hazard exists due to significant seepage at the toe of the dam. The spillway weir is judged to be stable for the expected loading conditions.

The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Fill in the low areas at the top of the embankment.

(2) Perform investigations and studies as necessary to assess the cause of the seepage observed at the dam and to determine if additional seepage is occurring to the left of the outlet works. This will probably require that the pool be drawn down below spillway crest for a brief period. These investigations and studies should address the potential of the seepage to cause piping and to adversely affect the embankment stability. Take appropriate action as required.

(3) Perform additional studies to more accurately ascertain the spillway capacity required for Saw Creek Club Dam as well as the nature and extent of measures required to provide adequate spillway capacity. The study should also address the capacity of the spillway outlet channel. Take appropriate action as required.

(4) Remove trees and brush from the embankment.

(5) Repair scoured concrete and the cracked wall at the spillway area.

All investigations, studies, designs, and supervision of construction should be performed by a professional engineer experienced in the design and construction of dams.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Saw Creek Club Dam.

(2) During periods of unusually heavy rains, continue to provide round-the-clock surveillance of Saw Creek Club Dam. Have sufficient personnel available to remove any debris that may collect at the spillway bridge.

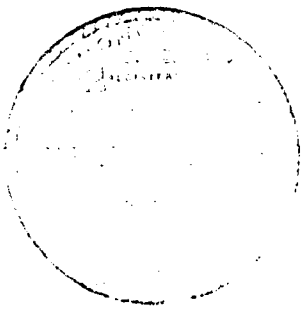
(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, institute a program of formal annual inspections by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(5) Expand the existing maintenance program to properly maintain all features of the dam.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



Frederick Futchko

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 21 March 1980

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

James W Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 10 APR 1980

SAW CREEK CLUB DAM

Overview

DELAWARE RIVER BASIN

SAW CREEK, PIKE COUNTY

PENNSYLVANIA

SAW CREEK CLUB DAM

NDI ID No. PA-00764
DER ID No. 52-7

SAW CREEK CLUB, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1980

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Saw Creek Club Dam is an earthfill and rockfill embankment. It is 500 feet long and its design height is 16 feet at maximum section. At present, the dam is 14 feet high. The concrete gravity spillway is located at the left abutment of the dam. The spillway is 154 feet long; the leftmost part of the axis of the weir deflects downstream. The spillway crest is 4.0 feet below the

design top elevation of the dam. A wooden bridge with concrete piers extends straight along the axis of the dam beyond the left end of the embankment. Some of the piers are at the spillway crest. The outlet works is located near the right abutment of the dam. It consists of a 36-inch diameter steel pipe with concrete entrance and outlet structures. Sluice gates are provided at both the upstream and downstream ends of the pipe. The embankment has a timber corewall except near the outlet works, where it has a concrete corewall. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E. The geology of the site is described in Appendix F.

b. Location. Saw Creek Club Dam is located on Saw Creek in Porter Township, Pike County, Pennsylvania, approximately 3.7 miles north of Ressaca.(1) Saw Creek Club Dam is shown on USGS Quadrangle, Twelvemile Pond, Pennsylvania, at latitude N 41° 09' 35" and longitude W 75° 04' 10". Twelvemile Pond, a natural impoundment, is within the Saw Creek Club Dam watershed about 1.5 miles northwest of the dam. A location map is shown on Plate E-1.

c. Size Classification. Small (14 feet high, 353 acre-feet - Existing Conditions).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Saw Creek Club Dam (Paragraphs 3.1e and 5.1c (5)).

e. Ownership. Saw Creek Club, Inc., Robert Fish, Steward, P.O. Box 209, Marshalls Creek, Pennsylvania 18335.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Data for the dam prior to 1919 are lacking, and the age of the dam is unknown. The earliest available information concerning Saw Creek Club Dam is a summary of pertinent data compiled in 1919 by the Pennsylvania Water Supply Commission (PWSC). The information consists of a brief description of the dam, which was described as a 530-foot long and 15-foot high earth and rockfill structure with a 92-foot long timber crib spillway. The dam was also described as leaking badly through the "base."

(1) Shown as Resica Falls on Commonwealth Road Maps.

Eugene H. Uhler, Consulting Engineer of Bethlehem, Pa., designed modifications to the dam in 1929. These modifications consisted of constructing a new spillway at the left abutment of the dam, removing the old spillway and constructing a concrete corewall and outlet works in its place, and raising the embankment. The PWSC reviewed and approved the design.

Mr. Uhler revised the design in 1930, apparently before construction had begun. These revisions included adding a bridge at the spillway and a powerhouse at the outlet works. The PWSC reviewed the revised plans and recommended revisions to the outlet works. These recommendations were incorporated into the plans. A permit for construction was issued in September 1930.

The work was accomplished by Horace H. Heller, a contractor and member of Saw Creek Club. The construction was inspected by the PWSC in late October 1930. Specifics concerning the construction are noted in Section 2. The inspector noted that unapproved modifications had been made to the dam.

Construction was almost completed in May 1931, when the dam again was inspected by the PWSC. The PWSC objected to the unapproved changes and requested that the Owner justify the modifications. Mr. Uhler responded that the contractor, despite Mr. Uhler's advice to the contrary, had made the changes without approval of the PWSC. It was his opinion that, even with the changes, the dam was well constructed. He stated, however, that he did not supervise construction. The PWSC requested as-built plans. Mr. Uhler had a survey performed and submitted the as-built plans to the PWSC in September 1931. The PWSC reviewed the plans and approved them in 1932.

The power generation did not prove successful and the generating facilities were removed at an unknown date. No other modifications have been made to the dam.

h. Normal Operational Procedure. The pool is maintained at the spillway crest level with excess inflow discharging over the spillway. The outlet works is not normally used. Spillway discharge flows downstream in Saw Creek to the confluence with Bush Kill.

1.3 Pertinent Data.

a. Drainage Area. (square miles)	16.0
b. Discharge at Damsite. (cfs.)	
Maximum known flood at damsite	1,400
Outlet works at maximum pool elevation	160
Spillway capacity at maximum pool elevation	
Design conditions	3,970
Existing conditions	1,510
c. Elevation. (feet above msl.)	
Top of dam	
Design conditions	969.0
Existing conditions	967.1
Maximum pool	
Design conditions	969.0
Existing conditions	967.1
Normal pool (spillway crest)	965.0
Upstream invert outlet works	952.7
Downstream invert outlet works	952.7
Streambed at toe of dam	952.7
d. Reservoir Length. (miles)	
Normal pool	0.71
Maximum pool (design)	0.77
e. Storage. (acre-feet)	
Normal pool	230
Maximum pool (design)	474
Maximum pool (existing conditions)	353
f. Reservoir Surface. (acres)	
Normal pool	56
Maximum pool (design)	66
g. Dam.	
Type	Earthfill and rockfill with corewall that is partially timber and partially concrete.

g.	Dam. (Cont'd.)	
	Length (feet)	500
	Height (feet)	
	Design	16
	Existing	14
	Topwidth (feet)	Varies, 10 to 12
	Side Slopes	
	As-Built	
	Upstream	Varies 1V on 1.9H to 1V on 1H
	Downstream	Varies 1V on 2.1H to 1V on 1.8H
	Zoning	Corewall. Extent of rockfill in the embankment is unkown.
	Cut-off	Concrete corewall founded on sandy gravel.
	Grout Curtain	None.
h.	Diversion and Regulating Tunnel.	None.
i.	Spillway.	
	Type	Concrete gravity weir.
	Length of Weir (feet)	153.5
	Crest Elevation	965.0
	Upstream Channel	Reservoir, vertical concrete walls.
	Downstream Channel	Grouted stone apron extending to channel along toe of dam.

j.	Regulating Outlets. Type.	One 36-inch diameter steel pipe.
	Length (feet)	63
	Closure	Sluice gates at upstream and downstream ends.
	Access	From top of dam.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. There are no data for the dam as originally constructed. Design data for the 1930 modifications that are available for review included the following: approved design drawings; as-built drawings; construction photographs; correspondence between the design engineer and the Commonwealth; foundation data from visual observations during construction; and permit application reports.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the Photographs in Appendix C and on Plates E-2 and E-3 in Appendix E. The embankment is shown on Photographs A through C. The spillway is shown on Photographs G and H. The outlet works is shown on Photographs C and D.

c. Design Considerations. There are insufficient data to assess the design.

2.2 Construction.

a. Data Available. No data are available for the construction of the original dam. Construction data available for review for the 1930 modifications included limited construction progress reports prepared by the Commonwealth, as-built drawings, photographs, and correspondence regarding construction.

b. Construction Considerations. Commonwealth inspection reports of the 1930 modifications noted minor discrepencies, such as small boulders projecting into the cut-off trench. However, they noted that good quality concrete was used and that the earthfill was of good quality and placed in a proper manner. Their only serious objections concerned the deviations from the design drawings. These deviations included changing the deflection angle of the spillway and making the embankment slopes steeper than approved.

2.3 Operation. There are no formal records of operation. A record of operation does exist in the form of

inspection reports prepared by the Commonwealth between 1919 and 1938. The findings of these inspections are discussed in other applicable sections of this Report.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). The Owner made available the club steward for information during the visual inspection. He stated that he had no written data concerning the structure. A member of the club did provide verbal recollections of the construction of the 1930 modifications.

b. Adequacy. The type and amount of available design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is fair. Deficiencies were observed as noted below. A sketch of the dam with the locations of deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is summarized in Appendix B. Datum for the survey was assumed at Elevation 965.0, based on the USGS map contours. To obtain correlation with the elevations shown on the Plates in Appendix E, 869.7 feet must be added to the elevations on the Plates. On the day of the inspection, the pool was 0.1 foot above spillway crest.

b. Embankment. The riprap on the upstream slope is in good condition. There is high grass and very low brush growing in the upstream slope (Photograph B). The downstream slope is slightly uneven. It has low brush and a few small trees growing on it (Photograph C). The brush is significantly thicker to the right of the outlet works, near the right abutment (Photograph I). To the left of the outlet works, the downstream toe is protected by large boulders. The boulders also act as the right bank of the spillway exit channel (Photograph A).

There was clear seepage to the right of the outlet works (Photograph I). The seepage was localized at certain areas. Some of the seepage flowed into a soft swampy area. The remainder flowed into a standing pool with no discernable outlet. The total seepage was estimated at about 30 gpm. The area is sketched in Appendix B. The flow conditions on the day of the inspection and the boulders along the toe made investigation of seepage to the left of the outlet works impossible.

The survey performed for this inspection reveals that there are many low areas on the top of the dam (Photographs E and F). The existing profile is shown in Appendix B. The lowest area is 1.9 feet below the design top elevation. The topwidth and downstream slope measured during the inspection agree approximately with the as-built drawing shown on Plate E-2 in Appendix E. The upstream slope could not be measured definitively

because of the minor portion above the water surface, although it appeared to be significantly flatter than the as-built drawings indicate.

c. Appurtenant Structures. The spillway is in fair condition. The left side of the spillway ends at a small retaining wall (Photograph H). The wall has shrinkage cracks. There is no backfill behind the wall. The right side of the spillway also ends at a wall, which retains the embankment and also acts as a bridge abutment. There is scour along the wall at normal pool level. At the upstream end of the wall, there is a crack through the wall with a 1/2-inch offset at the crack. The bridge piers that are along the spillway crest are scoured about 1 inch deep at normal pool level. The bridge itself, which is constructed of timber, was recently replaced and is in good condition. The mortar of the grouted stone masonry spillway apron is scoured 2 to 3 inches at some areas. Because of the flow conditions, not all of the toe of the apron could be inspected in detail. However, no deficiencies were observed at the toe of the apron. The spillway channel narrows rapidly downstream from the apron. Its right bank is the boulders placed at the toe of the dam. Its left bank is low, flat, and wooded. At the left end of the spillway apron, where the channel narrows, brush is growing at the toe of the apron.

The outlet works is in good condition. The gate operating mechanisms are well lubricated and appear to be well maintained. The only deficiency noted was the debris in the outlet of the 24-inch diameter outlet pipe (Photograph D). The steward of the club stated that the outlet works had been operated recently and that it was usually operated every month. The inspection team did not view its operation because the Club Steward departed before its operation could be requested.

d. Reservoir Area. The watershed area is over 90 percent wooded. Only a minor amount of rural development is present. The terrain varies from relatively steep areas to swamps in the valleys. Twelvemile Pond, a natural impoundment, is located within the watershed about 1.5 miles upstream from Saw Creek Club Dam (Photograph J). Data for Twelvemile Pond obtained during the visual inspection are included in Appendix B. Lake Minisink, another impoundment, is located within the watershed about 3.9 miles upstream from the dam.

e. Downstream Channel. At the damsite, the downstream channel is unobstructed and has relatively wide overbanks. About 1.8 miles downstream from the dam there is a new development, Saw Creek Estates. Five dwellings were observed adjacent to the stream, with 2 other dwellings under construction. About 2 miles downstream from these dwellings, the valley narrows and steepens at Winona Falls where the Magic Valley Amusement Park is located. Access could not be gained to this site. As viewed from the adjacent hillside, it appeared that at least some property damage would occur there, were the dam to fail. About 0.8 mile downstream of Winona Falls, there is another dwelling that would receive at least property damage from a failure of the dam. From that point, the stream extends about 0.8 mile to its confluence with Bush Kill. Downstream conditions are shown on Exhibit D-1 in Appendix D.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at the spillway crest level with excess inflow discharging over the spillway and into the downstream channel. The outlet works is normally not used.

4.2 Maintenance of Dam. The steward of the club is responsible for maintenance, with major repairs requiring approval of the club. The steward makes an informal inspection of the dam daily. Formal inspections are not made. The steward reported that an informal inspection by a contractor was made recently to aid the club in assessing the condition of the dam. The inspection reportedly found no items of immediate concern but some items that would eventually require repairs. Drawdown permits were issued in 1961, 1965, 1966, and 1972 to accomplish maintenance of the dam. Brush is reportedly cut twice a year.

4.3 Maintenance of Operating Facilities. The outlet works is operated once a month and the operating mechanisms are lubricated as needed.

4.4 Warning Systems in Effect. The steward stated that he was not aware of any emergency operation and warning system. He stated that during heavy rains he is at the site almost continuously and monitors the condition of the dam.

4.5 Evaluation of Operational Adequacy. The maintenance of the embankment and spillway is fair. Maintenance of the outlet works is good. Formal inspections are necessary to detect hazardous conditions at the dam. An emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The Commonwealth analyzed the spillway capacity for the 1930 modifications to the dam. Using a crest length of 150 feet and a discharge coefficient of 4.5, they estimated the design spillway capacity at 5,400 cfs. As noted in Paragraph 1.2g, the spillway crest length was increased by the design engineer to 156 feet. Bridge piers were also added along part of the crest. The bridge piers and crest length are discussed below. The discharge coefficient used by the Commonwealth is not realistic. A discharge coefficient of 3.3 is used in this Report, as noted in Appendix D. The design drainage area of 16.4 square miles was obtained from 1930 mapping. The drainage area of 16.0 square miles used in this Report is based on recent USGS mapping.

b. Experience Data. A member of the club said that the highest flow, in his recollection, was during Tropical Storm Diane in 1955, when the pool level was near the top of the dam and water almost encircled the clubhouse. The estimate of 1,400 cfs used in this Report is based on the pool level being 0.1 foot below the existing top of the dam.

c. Visual Observations.

(1) General. The visual inspection of Saw Creek Club Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The low areas on the top of the dam limits the existing spillway capacity to less than the design capacity. The low areas at the right abutment beyond the clubhouse do not present a hazard to the dam because any flow through them would be directed away from the toe of the embankment.

(3) Appurtenant Structures. The low area at the left end of the spillway does not present a hazard to the dam. Erosion in this area would not threaten the

impoundment. The low area with the missing backfill behind the wall at the left end provides additional discharge capacity. Its effects are minimal and they have been ignored in the analysis described hereafter. The brush at the toe of the apron in this area is sufficiently low that it will not affect the hydraulics of the spillway. The spillway crest length measured for this inspection is 153.5 feet, which is slightly shorter than the length of 156 feet indicated on Plate E-2. Three of the bridge piers reduce the effective crest length. The other bridge piers are not along the crest and will not have a significant effect on the hydraulics. The bridge itself has the potential to collect debris, as the underside of the bridge is only 0.1 foot above design top of dam elevation. However, the hazard is minimal at present because the underside is 2.0 feet above the low areas at the top of the dam. The low left overbank of the spillway exit channel will provide sufficient capacity to keep water from flowing above the boulders at the toe of the dam. This would not necessarily be true if the design spillway capacity were increased.

The debris at the outfall of the 24-inch diameter pipe at the outlet works is of no concern because the pipe is not a functional part of the outlet works; the pipe was used for the power generating facilities that are no longer at the dam. The gate at the upstream end of the outlet works provides upstream closure facilities.

(4) Reservoir Area. No estimate of reservoir storage is available for the design of the 1930 modifications to the dam. The storage recorded in the Commonwealth records was computed after 1938 and does not correlate well with the other existing data. The basis of their estimate is not available. The estimate of storage used in this Report is based on areas determined from USGS mapping. As no feature of the dam is referenced accurately to USGS datum, the estimate of storage is approximate. Twelvemile Pond does have a significant effect on the hydrology of Saw Creek Club Dam. Its effects have been included in the analysis described hereafter. Lake Minisink is quite far from the dam and has a much smaller pool area (about 45 acres) than Twelvemile Pond. The hydrologic effects of Lake Minisink on the Saw Creek Club hydrology are considered minimal and have not been included in the analysis. No conditions were observed in the watershed that might present a significant hazard to Saw Creek Club Dam.

(5) Downstream Conditions. No conditions were observed downstream that would reduce the hydraulic capacity of the spillway. Failure of Saw Creek Club Dam would probably flood at least 5 dwellings and part of an amusement park. The downstream conditions indicate that a high hazard classification is warranted for Saw Creek Club Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size (Small) and hazard potential (High) of Saw Creek Club Dam is between one-half of the Probable Maximum Flood (PMF) and the PMF. Because of the downstream conditions, the PMF is selected as the SDF for Saw Creek Club Dam. The watershed was modeled with the HEC-1DB computer program. A description of the model is included in Appendix D. The assessment of the dam is based on existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that Saw Creek Club Dam can pass about 9 percent of the PMF before overtopping of the dam occurs. The dam is rated at its existing top elevation. At its design top elevation, the dam can pass about 22 percent of the PMF.

(3) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix D. Because an occurrence of the 1/2 PMF would result in overtopping of the dam, a failure analysis was performed. Both the 15 percent PMF and the 1/2 PMF were used to determine the spillway adequacy of Saw Creek Club Dam. Assumptions used to model the failure are described in Appendix D. The resulting outflow was routed through stream sections downstream to dwellings located along Saw Creek. It was found that failure of Saw Creek Club Dam by the 15 percent PMF would raise water levels at the dwellings by 3.2 feet over the levels that existed just prior to failure. For the 1/2 PMF, it was found that failure of the dam would not raise the water levels at the dwellings by any significant amount over the levels that existed just prior to failure. However, the failure of the dam would cause flooding about 4 hours before the peak flooding caused by the 1/2 PMF. For a dam failure from the 15 percent PMF or the 1/2 PMF, there is an increased hazard for loss of life. Therefore, the spillway capacity is rated as seriously inadequate. If the dam were raised to its design elevation, the spillway capacity would still be rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Saw Creek Club Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The growth of trees on the embankment slopes is a hazard to the dam. Root systems can loosen embankment material, displace slope protection, and create paths along which seepage and piping (internal erosion) might occur. The hazard is minimal at present because of the small size of the trees. The uneveness of the downstream slope is probably the result of poor construction grading; it is not of concern.

The seepage to the right of the outlet works is evaluated in Paragraph 6.1b.

The low area near the middle of the embankment is probably caused by settlement. The low areas at each end of the dam are probably caused by poor construction practice. The slopes of the embankment are evaluated in Paragraph 6.1c.

(3) Appurtenant Structures. As noted in Section 5, the deterioration of the wall at the left end of the spillway is no hazard to the dam and is therefore of no concern. The scour observed at the spillway apron, bridge piers, and at the wall at the right end of the spillway is caused by long-term exposure to flowing water. The scour is not sufficiently severe to be of major concern at present. The crack in the wall at the right end of the spillway was probably caused by frost heave. The embankment at the wall is low, and it is not felt that the normal soil loadings caused the crack. However, the crack prevents the wall from acting as an impervious barrier.

No structural deficiencies were observed at the outlet works.

b. Design and Construction Data. The original Saw Creek Club Dam was an earthfill embankment with a dry masonry (rockfill) downstream face. A timber sheet corewall was provided in the dam. Photographs taken during the 1930 modifications to the dam indicate that the part of the timber corewall that was exposed during construction was in good condition. The records of the inspections made during construction of the 1930 modifications indicate that the foundation at the outlet works and spillway was a "hard compacted sandy gravel." It is assumed that the entire dam is founded on this material. The 1930 modifications to the dam consisted, in part, of removing the old timber crib spillway and constructing the existing outlet works. A concrete corewall extends across this reach. Except in the above reach, the embankment was modified by placing new earthfill on the dry masonry (rockfill) downstream slope of the old embankment. The available records indicate that the only post-construction inspection of the dam was performed by the Commonwealth in 1938, when the downstream toe to the right of the outlet works was described as swampy. A full assessment of the seepage at the dam that was observed during the inspection for this Report would depend on the amount and location of seepage, if any, occurring to the left of the outlet works. As noted in Section 3, it was not possible to determine if any seepage was occurring to the left of the outlet works. It is surmised that deterioration of the timber corewall has resulted in the observed seepage to the right of the outlet works. The seepage is considered excessive because its localized nature creates significant velocities, which could erode the embankment.

No stability analysis is available for the embankent. Nor is one available for the spillway weir, which is a low structure. By reviewing the weir section on Plate E-2 in Appendix E, it is judged that the weir should be stable for the anticipated loading conditions.

c. Operating Records. There are no formal records of operation. The available data indicates that the pool has been drawn down occassionally for maintenance purposes. The embankment has withstood high pool conditions during Tropical Storm Diane. Furthermore, a member of the club stated that the power generating facilities at the dam were not successful because the facilities kept drawing down the pool.

The slopes of the embankment are steeper than those that would normally be used for a dam of this type. However, the dam has withstood various operating conditions with no evidence of stability problems. Therefore, the embankment slopes should be adequate if the seepage at the embankment has not changed the conditions in the embankment that existed when the operating conditions were experienced.

d. Post-Construction Changes. The 1930 modifications to the dam is evaluated above.

e. Seismic Stability. Saw Creek Club Dam is located in Seismic Zone 1. Earthquake loadings are not considered to be significant for small dams located in Zone 1 when there are no readily apparent stability problems at the dam. If an assessment of the seepage at the dam indicates that it does not adversely affect the structural stability of the embankment, the ability of the embankment to resist earthquake loadings should be adequate.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED

REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Saw Creek Club Dam is judged to be in fair condition. Based on existing conditions, the spillway will pass about 9 percent of the PMF before overtopping of the dam occurs. Based on the criteria and the downstream conditions, the PMF is the Spillway Design Flood for the dam. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass about 22 percent of the PMF. Failure of the dam would cause an increased hazard for loss of life downstream. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the spillway capacity is rated as seriously inadequate and the dam is classified as unsafe, non-emergency.

(2) No stability problems were evident for the embankment at the time of the visual inspection, but a potential hazard exists due to significant seepage at the toe of the dam.

(3) The spillway weir is judged to be stable for the expected loading conditions.

(4) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiency
Embankment:	Low areas at top; brush and trees; seepage.
Spillway:	Scour at various areas; right approach wall cracked.

b. Adequacy of Information. The information available is such that a preliminary assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Fill in the low areas at the top of the embankment.

(2) Perform investigations and studies as necessary to assess the cause of the seepage observed at the dam and to determine if additional seepage is occurring to the left of the outlet works. This will probably require that the pool be drawn down below spillway crest for a brief period. These investigations and studies should address the potential of the seepage to cause piping and to adversely affect the embankment stability. Take appropriate action as required.

(3) Perform additional studies to more accurately ascertain the spillway capacity required for Saw Creek Club Dam as well as the nature and extent of measures required to provide adequate spillway capacity. The study should also address the capacity of the spillway outlet channel. Take appropriate action as required.

(4) Remove trees and brush from the embankment.

(5) Repair scoured concrete and the cracked wall at the spillway area.

All investigations, studies, designs, and supervision of construction should be performed by a professional engineer experienced in the design and construction of dams.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Saw Creek Club Dam.

(2) During periods of unusually heavy rains, continue to provide round-the-clock surveillance of Saw Creek Club Dam. Have sufficient personnel available to remove any debris that may collect at the spillway bridge.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, institute a program of formal annual inspections by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(5) Expand the existing maintenance program to properly maintain all features of the dam.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: SAW CREEK CLUB

NDI ID NO.: PA-00764 DER ID NO.: 52-7

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	SEE PLATE E-2
REGIONAL VICINITY MAP	SEE PLATE E-1
CONSTRUCTION HISTORY	BUILT PRIOR 1919 MODIFIED 1930
TYPICAL SECTIONS OF DAM	SEE PLATE E-2
OUTLETS: Plan Details Constraints Discharge Ratings	SEE PLATE E-3 NO RATINGS AVAILABLE

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics (H&H) Dam Stability Seepage Studies	NO STABILITY OR SEEPAGE ANALYSIS NO H&H FOR AS-BUILT
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE EXCEPT FIELD OBSERVATIONS
POSTCONSTRUCTION SURVEYS OF DAM	See "AS-BUILT DRAWINGS"

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	NOT IN RECORDS
MONITORING SYSTEMS	NONE
MODIFICATIONS	1930 MODIFICATION
HIGH POOL RECORDS	1955 - TROPICAL STORM DIANE - WATER ALMOST AT TOP.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	No formal records
SPILLWAY: Plan Sections Details	See Plate E-2
OPERATING EQUIPMENT: Plans Details	See Plate E-3
PREVIOUS INSPECTIONS Dates Deficiencies	1919 - "Leaks badly thru. base." 1931 - No seepage, modification under construction, slope at right end too steep. 1938 - Seepage at blowoff, swampy near right end.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: SAW CREEK CLUB County: PIKE State: PENNSYLVANIA

NDI ID No.: PA-00764 DER ID No.: 52-7

Type of Dam: EARTHFILL Hazard Category: HIGH

Date(s) Inspection: 15 NOVEMBER 1979 Weather: CLEAR - CALM Temperature: 35-40°F

SOIL CONDITIONS: MOIST

Pool Elevation at Time of Inspection: 965.1 msl/Tailwater at Time of Inspection: 955.2 * msl

* DOWNSTREAM END OF SPILLWAY CHANNEL.

Inspection Personnel:

D. WILSON (GFCC)

D. EBERSOLE (GFCC)

R. FISH (STEWARD OF CLUB)

A. WHITMAN (GFCC) Recorder

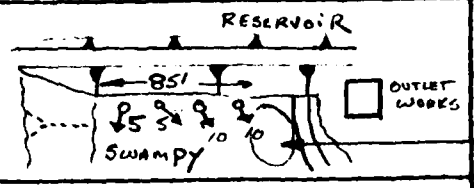
EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	NONE	
CREST ALIGNMENT: Vertical Horizontal	HORIZONTAL: NO DEFICIENCIES VERTICAL: SEE SURVEY DATA FOLLOWING FORMS	
RIPRAP FAILURES	NONE	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	LOW AREAS - SEE SURVEY DATA	
ANY NOTICEABLE SEEPAGE		SEEPAGE POINT - FLOW IN 8pm 10'x20' POND - NO EVIDENT OUTLET
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
VEGETATION	HIGH GRASS - VERY LOW BRUSH ON UPSTREAM SLOPE. BRUSH AND SMALL TREES ON DOWNSTREAM SLOPE - ESPECIALLY NEAR RIGHT ABUTMENT.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	NOT VISIBLE	
INTAKE STRUCTURE	SUBMERGED	
OUTLET STRUCTURE	OLD POWERHOUSE	
OUTLET CHANNEL	NATURAL STREAM	
EMERGENCY GATE	UPSTREAM GATE - WELL GREASED DOWNSTREAM GATE - GOOD CONDITION	UPPER LEVEL (24" DIA.) PIPE HAS debris IN OUTLET, NOT OPERATED.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Spillway Apron scoured: 2"-3" deep at areas	Brush at toe of spillway left end Shrinkage cracks at left [illegible] wall, which has no backfill behind it.
APPROACH CHANNEL	Approach wall at right end: cracked with 1/2" offset. Scour along wall at normal pool level.	
DISCHARGE CHANNEL	Flows along toe of dam, which has heavy stone alongside channel in some areas.	Left overbank is low.
BRIDGE AND PIERS	Bridge: Good Condition. Scour at normal pool level at piers: 2" max, 1" typical depth	

B-5

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER	NONE	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	AT DAM: NO DEFICIENCIES.	
SLOPES	RELATIVELY MILD	
APPROXIMATE NUMBER OF HOMES AND POPULATION	SAW CREEK ESTATES: 5 HOMES + 2 UNDER CONST. MAGIC VALLEY: DAMAGE 2 OTHER HOMES FURTHER DOWNSTREAM WOULD BE DAMAGED.	} IN FLOODPLAIN.

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	AT RESERVOIR, FAIRLY GENTLE.	
SEDIMENTATION	NO REPORTED OR OBSERVED PROBLEMS.	
WATERSHED DESCRIPTION	MOSTLY WOODED SOME SCATTERED MINOR RURAL DEVELOPMENT	

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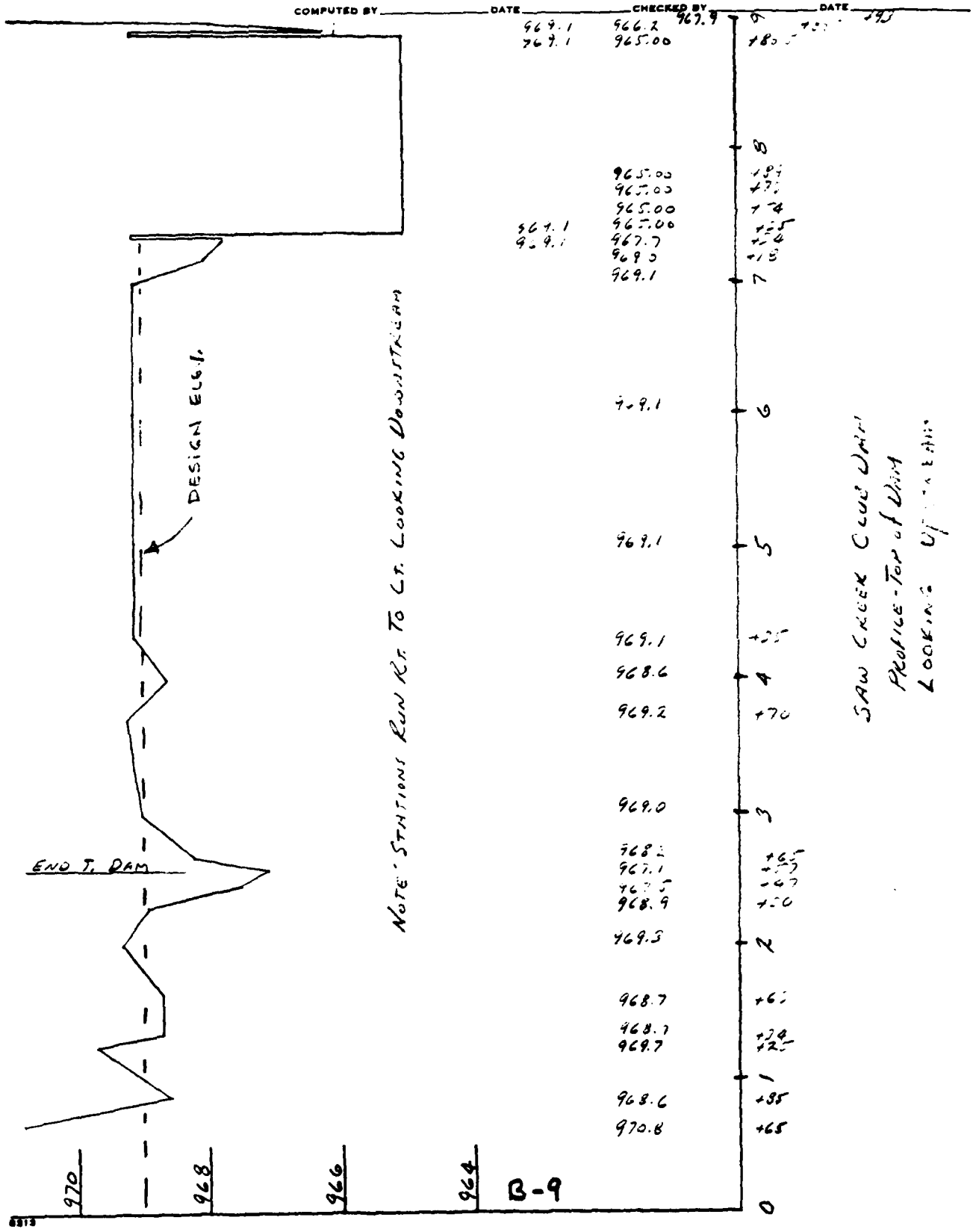
SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



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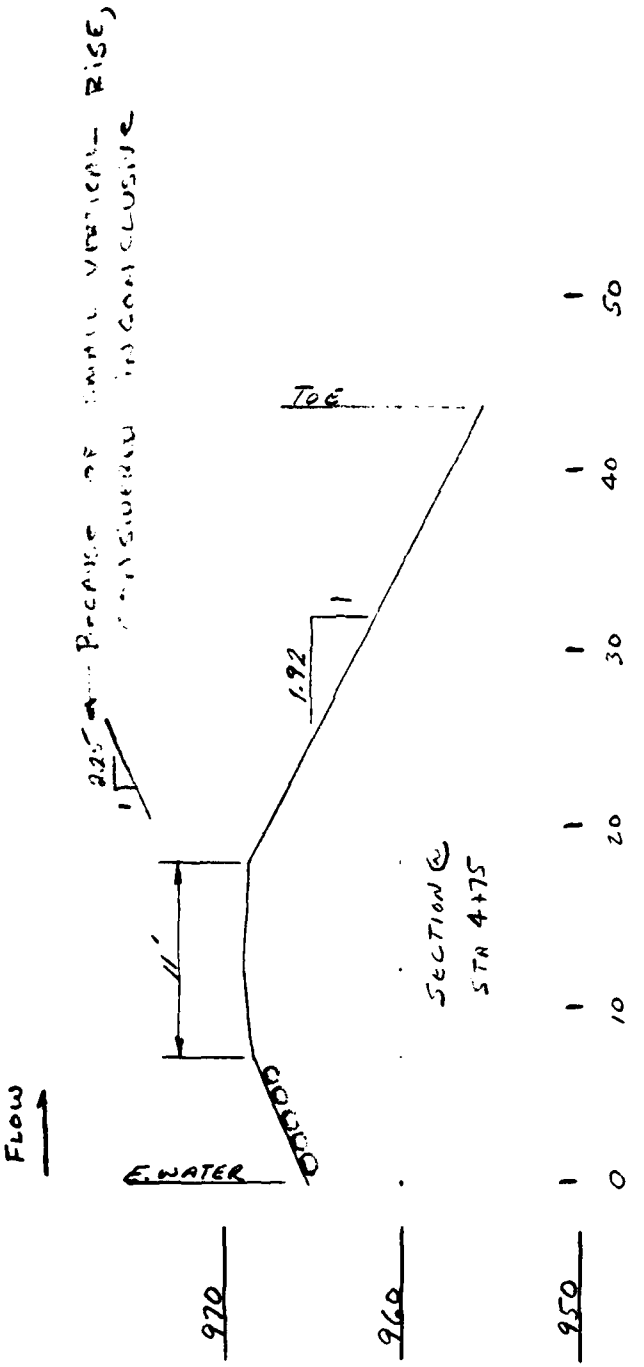
FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SAW CREEK CLUB DAM
SCALE 1" = 10'

B-10

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SHEET NO. ____ OF ____ SHEETS
FOR _____
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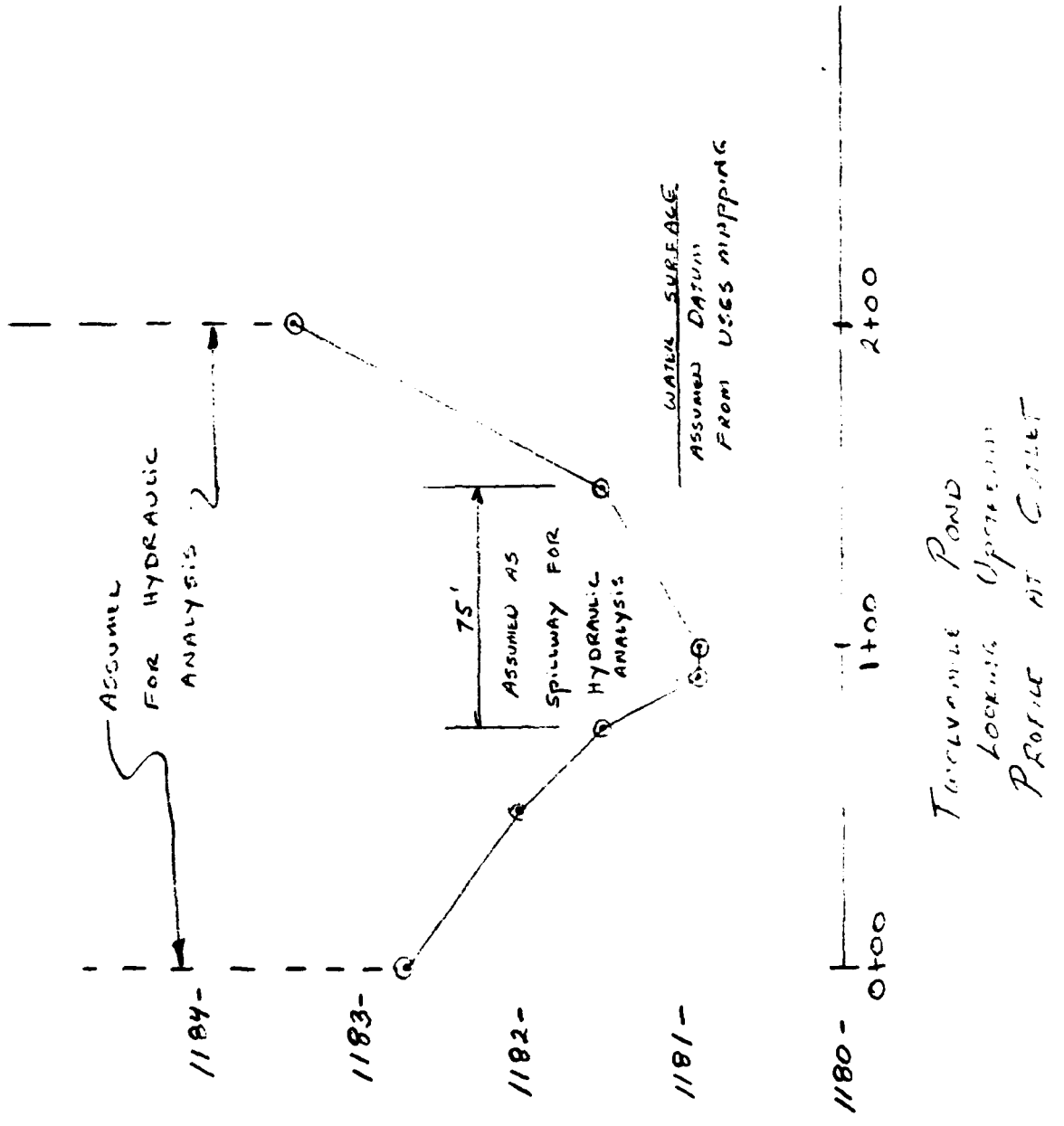
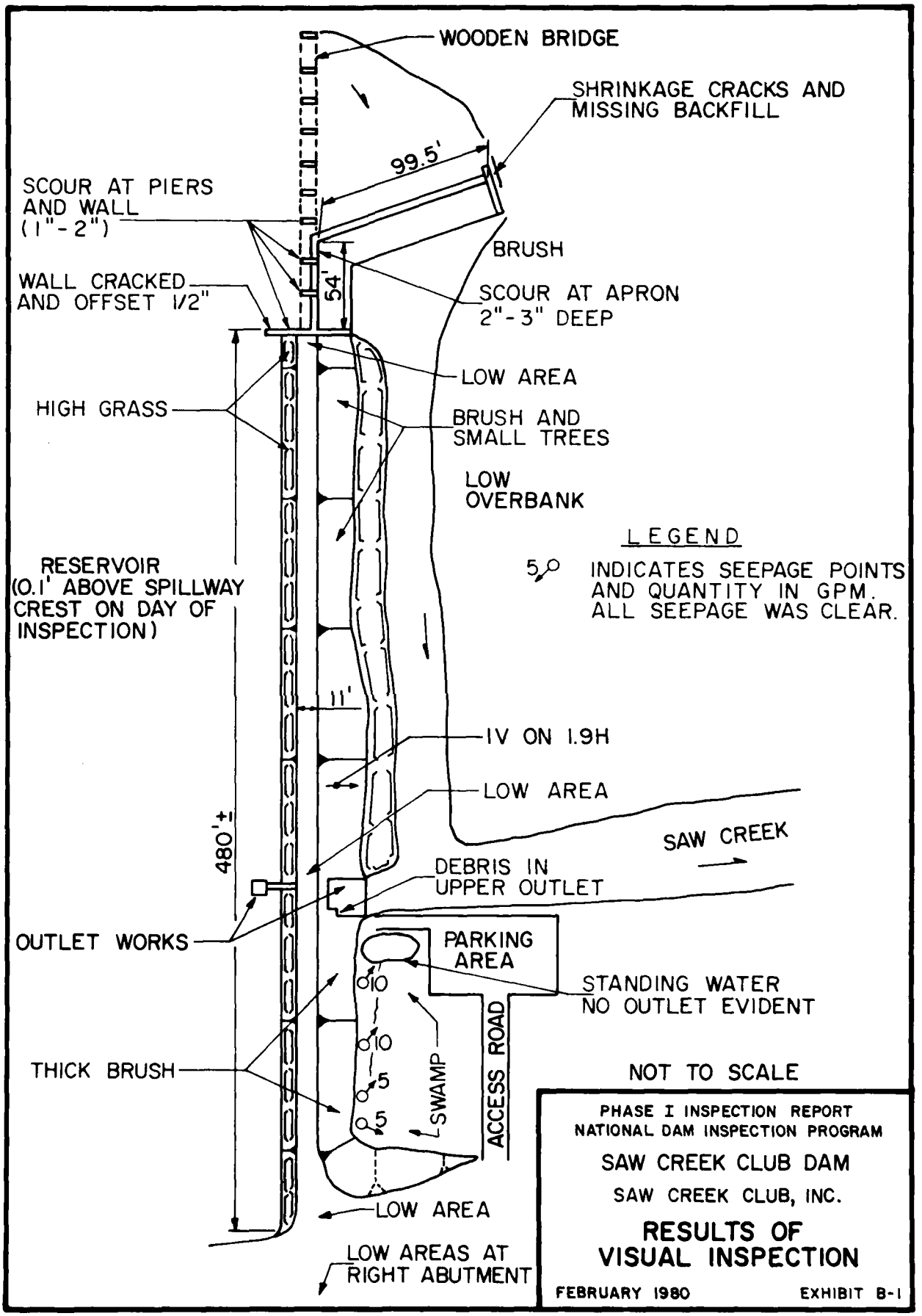


B-11


WOODEN BRIDGE
SHRINKAGE CRACKS AND MISSING BACKFILL
99.5'
SCOUR AT PIERS AND WALL (1"-2")
BRUSH
54'
WALL CRACKED AND OFFSET 1/2"
SCOUR AT APRON 2"-3" DEEP
LOW AREA
HIGH GRASS
BRUSH AND SMALL TREES
LOW OVERBANK
LEGEND
5 INDICATES SEEPAGE POINTS AND QUANTITY IN GPM. ALL SEEPAGE WAS CLEAR.
RESERVOIR (0.1' ABOVE SPILLWAY CREST ON DAY OF INSPECTION)
11'
1V ON 1.9H
LOW AREA
480'±
SAW CREEK
DEBRIS IN UPPER OUTLET
OUTLET WORKS
PARKING AREA
10
STANDING WATER NO OUTLET EVIDENT
10
THICK BRUSH
5
SWAMP
ACCESS ROAD
5
NOT TO SCALE
LOW AREA
LOW AREAS AT RIGHT ABUTMENT
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SAW CREEK CLUB DAM
SAW CREEK CLUB, INC.
RESULTS OF VISUAL INSPECTION
FEBRUARY 1980
EXHIBIT B-1

APPENDIX C

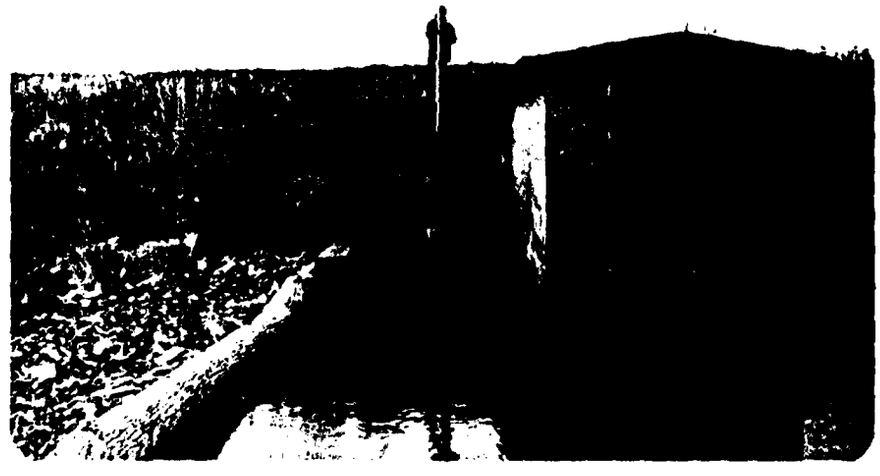
PHOTOGRAPHS

SAW CREEK CLUB DAM

A. Downstream Slope

B. Upstream Slope

C. Top of Dam and Outlet Works



D. Outlet Structure

E. Low Area Near Spillway

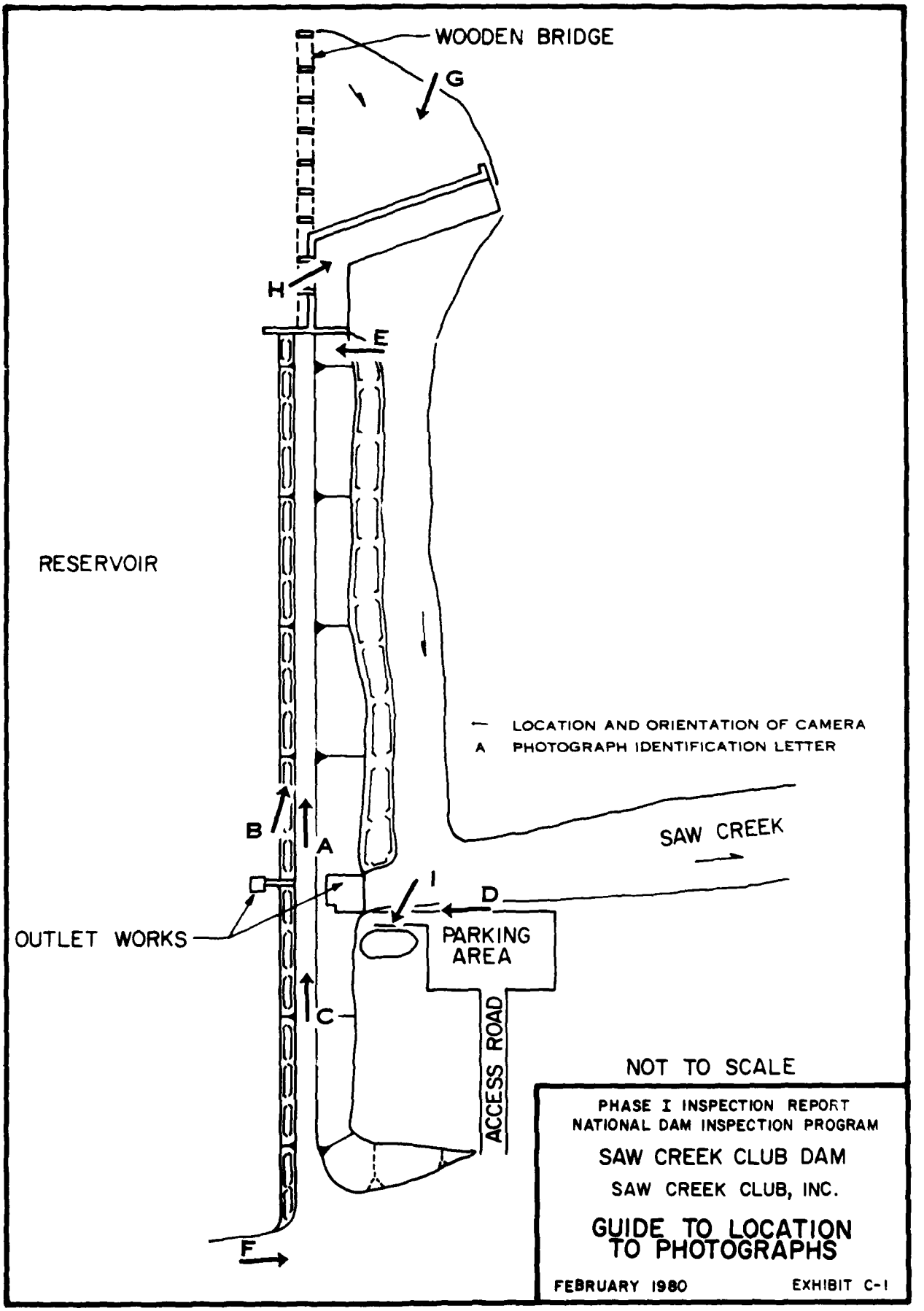
F. Low Area at Right Abutment

G. Spillway

H. Left End of Spillway

I. Seepage Area Near Right Abutment

J. Twelvemile Pond - Upstream of Saw Creek Club Dam


WOODEN BRIDGE
G
H
E
RESERVOIR
LOCATION AND ORIENTATION OF CAMERA
A PHOTOGRAPH IDENTIFICATION LETTER
B
A
SAW CREEK
I
D
OUTLET WORKS
PARKING AREA
C
ACCESS ROAD
F
NOT TO SCALE
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SAW CREEK CLUB DAM
SAW CREEK CLUB, INC.
GUIDE TO LOCATION TO PHOTOGRAPHS
FEBRUARY 1980
EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

DELAWARE River Basin
Name of Stream: SAW CREEK
Name of Dam: SAW CREEK CLUB
NDI ID No.: PA-00764
DER ID No.: 52-7
Latitude: N 41° 09' 35" Longitude: W 75° 04' 10"
Top of Dam Elevation: 969.0 (design)
Streambed Elevation: 952.7 Height of Dam: 16 ft
Reservoir Storage at Top of Dam Elevation: 474 acre-ft
Size Category: SMALL
Hazard Category: HIGH (see Section 5)
Spillway Design Flood: VARIES ½ PMF TO PMF
SELECT PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
LAKE MINISINK	3.9	3	350	DER ID 52-75 *
TWELVEMILE POND	1.5	2+/-	N/A	DER ID 52-35 †

DOWNSTREAM DAMS

* ASSUMED NEGLIGIBLE IN ANALYSIS
† DER BULLETIN No 5 LISTING IS IN ERROR

DELAWARE River Basin

Name of Stream: SAW CREEK

Name of Dam: SAW CREEK CLUB

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A1	1.46	0.45	1.23	1.76	0.8	N/A	1.36	1	A
A2	14.58	0.45	1.23	10.80	4.51	N/A	3.95	1	A
Total	16.04								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

PMF Rainfall Index= 22.0 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	1
Geographic Adjustment Factor:	N/A	1.0
Revised Index Rainfall:	N/A	22.0

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	106
12 hours	118
24 hours	128
48 hours	137
72 hours	N/A
96 hours	N/A

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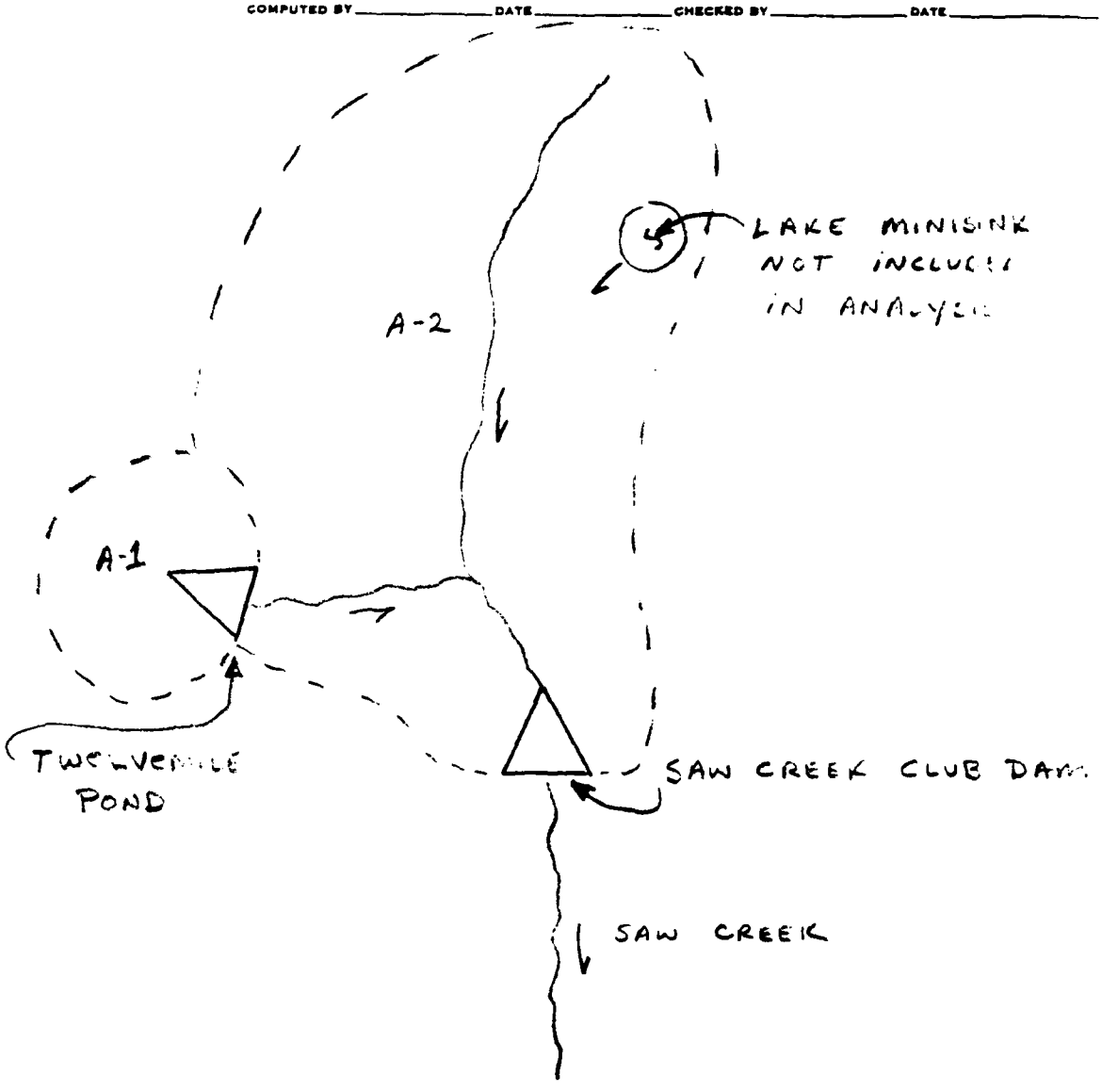

SKETCH
OF
SYSTEM

8313

Data for Dam at Outlet of Subarea A-1 (See sketch on Sheet D-4)

Name of Dam: TWELVEMILE POND

STORAGE DATA:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1179.4 =ELEVO*	0	0	0	
~~1180.9 =ELEV1~~	164 =A1		~~82 =S1~~	
1181.0 = ELEV1	187		100 =51†	SEE BELOW
1185.0	247		965	
1190.0	333		2408	
1200.0 **	544			

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

† ARBITRARY STORAGE

Reservoir Area at Normal Pool is 20 percent of subarea watershed.

BREACH DATA: NOT USED

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)
Z = _____ (side slopes of breach)
ELBM = _____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = _____ (normal pool elevation)
T FAIL= _____ mins = _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-1

Name of Dam: TWELVEMILE POND

SPILLWAY DATA:	Existing Conditions	Design Conditions
Top of Dam Elevation	SEE FOLLOWING SHEET	N/A
Spillway Crest Elevation		
Spillway Head Available (ft)		
Type Spillway		
"C" Value - Spillway		
Crest Length - Spillway (ft)		
Spillway Peak Discharge (cfs)		
Auxiliary Spillway Crest Elev.		
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		N/A

Spillway Rating Curve: SEE FOLLOWING SHEET

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
1180.9	0		0
1181.3	17		17
1181.6	73		73
1182.2	285		285
1183.7	925		925
1185.1	1,744		1,744
1186.5	2,788		2,788

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	NONE	NONE	NONE
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction=$29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5}$ = C			
Maximum Head (ft) = HM			
Q = $CA\sqrt{2g(HM)}$(cfs)			
Q Combined (cfs)			

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

OUTLET OF TWELVEMILE POND
RATING CURVE
SEE APPENDIX B

USING $Q = \frac{2.7}{3.1}\sqrt{\frac{A^3 g}{T}}$ (CRITICAL DEPTH, ADJUSTED)

Q = FLOW
g = 32.18 FT²/SEC
A = AREA OF FLOW
T = TOPWIDTH OF FLOW

AND POOL = INVERT + DEPTH + hV

WHERE $hV = \frac{Q^2}{2gA^2}$, INVERT = 1180.1

DEPTH	A	T	Q	hV	POOL
0	0	10	0	0	1180.9
0.3	7.88	42.5	17	.07	1181.3
0.6	25.5	75	73	.13	1181.6
1.1	63	75	285	.32	1182.3
2.1	138	75	925	.70	1183.7
3.1	213	75	1,774	1.08	1185.1
4.1	288	75	2,788	1.46	1186.5

Data for Dam at Outlet of Subarea A-2 (See sketch on Sheet D-4)

Name of Dam: SAW CREEK CLUB

STORAGE DATA: BASED ON SPILLWAY CREST AT EL. 965.0, WHICH WAS ESTIMATED FROM USGS MAPPING.

Elevation		Area (acres)		Storage million gals	acre-ft		Remarks
952.7	=ELEVO*	0		0	0		STREAM BED AT TOE OF DAM
965.0	=ELEV1	56	=A1		230	=S1*	
967.1		61			353		
969.0		66			474		
980.0	**	98					

* ~~ELEVO = ELEV1 = (3S/A1)~~ $S_1 = A_1 (ELEV1 - ELEVO)/3$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is NEGL percent of subarea watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: SILTY SAND

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 2 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = .18 ft., C = 3.1 Top of Dam El.= 967.1

HMAX + Top of Dam El. = 967.3 = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 80 ft (width of bottom of breach)
Z = 1 (side slopes of breach)
ELBM = 952.7 (bottom of breach elevation, minimum of zero storage elevation)
WSEL = 965.0 (normal pool elevation)
T FAIL= 6 mins = 0.1 hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-2

Name of Dam: SAW CREEK CLUB

SPILLWAY DATA:

	Existing Conditions	Design Conditions
Top of Dam Elevation	967.1	969.0
Spillway Crest Elevation	965.0	965.0
Spillway Head Available (ft)	2.1	4.0
Type Spillway	CONCRETE - GRAVITY	
"C" Value - Spillway	3.3 †	3.3 †
Crest Length - Spillway (ft)	150.5 ★	150.5 ★
Spillway Peak Discharge (cfs)	1,511	2,973
Auxiliary Spillway Crest Elev.	N/A	N/A
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)	N/A	N/A
Combined Spillway Discharge (cfs)	≈ 1,510	≈ 3,970

† KINGS HANDBOOK OF HYDRAULICS PAGE 5-9 FIG 76.

Spillway Rating Curve: $Q = CLH^{3/2}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
NOT USED			

★ CREST LENGTH REDUCED BECAUSE OF PIERS.

OUTLET WORKS RATING:

	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	952.7		
Invert of Inlet	952.7		
Type	STEEL		
Diameter (ft) = D	3		
Length (ft) = L	63		
Area (sq. ft) = A	7.07		
N	.011		
K Entrance	0.5		
K Exit	1.0		
K Friction=$29.1 N^2 L/R^{4/3}$	0.33		
Sum of K	1.83		
$(1/K)^{0.5} = C$	0.74		
Maximum Head (ft) = HM	15		
$Q = CA\sqrt{2g(HM)}$ (cfs)	163		
Q Combined (cfs)	≈ 160		

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SELECTED COMPUTER OUTPUT
EXISTING CONDITIONS

† PLAN 1: ASSUMES NO FAILURE OF ANY DAM
PLAN 2: ASSUMES FAILURE OF SAW CREEK CLUB DAM
PEAK FLOWS IN MULTI-RATIO ANALYSIS VARY SLIGHTLY FROM BREACH ANALYSIS BECAUSE OF DIFFERENT TIME PERIOD USED

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EXISTING COND.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 JAN 80
**********
    1              A1                                NATIONAL DAM INSPECTION PROGRAM
    2              A2                                        SAW CREEK
    3              A3                                  SAW CREEK CLUB DAM
    4              B     300        0       15        0        0        0        0        0       -4        0
    5              B1      5
    6              J       1        0        1
    7              J1      1       .5       .4       .3       .2       .15      .1       .05      .03
    8              K       0        1                                                    1
    9              K1        RUNOFF INTO TWELVEMILE POND
   10              M       1        1     1.46                16                                  1
   11              P                22.0      106      118      128      137
   12              T                                                                    1       .05                .2
   13              W     1.36      .45
   14              X     -1.5    -0.05      2.0
   15              K       1        1                                                    1
   16              K1        ROUTE THROUGH TWELVEMILE POND
   17              Y                                  1
   18              Y1      1                                                  -1180.9      -1
   19              Y4 1180.9   1181.3   1181.6   1182.3   1183.7   1185.1   1186.5
   20              Y5      0       17       73      285      925     1744     2788
   21              $A      0      187      544
   22              $E1179.4     1181     1200
   23              $S1180.9
   24              $D1181.5
   25              $L      0       38      109      125      125
   26              $Y1181.5   1182.0   1182.7   1183.4     1200
   27              K       1        2                                                    1
   28              K1        ROUTE TO SAW CREEK
   29              Y                                  1
   30              Y1      1                                                    -1
   31              Y6    .09      .07      .09     1165     1175     2200     .009
   32              Y7      0     1200      150     1180      300     1170      350     1165      400     1165
   33              Y7    450     1170     1150     1180     2300     1200
   34              K       1        3                                                    1
   35              K1        ROUTE TO SAW CREEK CLUB DAM
   36              Y                                  1
   37              Y1      1                                                    -1
   38              Y6    .09      .07      .09      997     1007     6100     .013
   39              Y7      0     1060      110     1060      230     1020      650     1000      810      997
   40              Y7   1090     1000     1220     1020     1310     1040
   41              K       0        4                                                    1
   42              K1        UNCONTROLLED RUNOFF INTO SAW CREEK CLUB DAM
   43              M       1        1    14.58               16.0                                 1
   44              P                22.0      106      118      128      137
   45              T                                                                    1       .05
   46              W     3.05     0.65
   47              X     -1.5    -0.05      2.0
   48              K       2        4                                                    1
   49              K1        COMBINE RUNOFF INTO SAW CREEK CLUB DAM
   50              Y       1        2                                                    1
```

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51          K1      ROUTE THROUGH SAM CREEK CLUB DAM
52          Y                                   1
53          Y1      1                                                   -965        0
54          SA      0       56      98
55          SE  952.7       965     980
56          SS      965     150.5   3.3     1.5
57          SD  967.1
58          SL      1       15      10      40      75      120     295     615     650
59          SV  967.1   967.5   967.7   968     968.6   968.7   969.1   969.2   979
60          K       99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .15	RATIO 7 .10	RATIO 8 .05	RATIO 9 .03
HYDROGRAPH AT	1	1.46 (3.78)	1	3484. (98.66)	1742. (49.53)	1394. (39.46)	1045. (29.60)	697. (19.73)	523. (14.80)	348. (9.87)	174. (4.93)	105. (2.96)
ROUTED TO	1	1.46 (3.78)	1	2388. (67.61)	991. (28.07)	724. (20.49)	466. (13.19)	244. (6.90)	156. (4.42)	73. (2.07)	17. (.47)	10. (.29)
ROUTED TO	2	1.46 (3.78)	1	2384. (67.52)	989. (28.01)	722. (20.44)	465. (13.18)	243. (6.89)	156. (4.42)	73. (2.06)	17. (.47)	10. (.29)
ROUTED TO	3	1.46 (3.78)	1	2355. (66.69)	971. (27.49)	706. (19.98)	455. (12.88)	238. (6.75)	153. (4.32)	71. (2.02)	17. (.47)	10. (.28)
HYDROGRAPH AT	4	14.58 (37.76)	1	18248. (516.74)	9124. (258.37)	7299. (206.69)	5475. (155.02)	3650. (103.35)	2737. (77.51)	1825. (51.67)	912. (25.84)	547. (15.50)
2 COMBINED	4	16.04 (41.54)	1	20603. (583.42)	10059. (284.83)	7958. (225.35)	5869. (166.18)	3837. (108.65)	2839. (80.38)	1865. (52.80)	922. (26.10)	553. (15.67)
ROUTED TO	4	16.04 (41.54)	1	20577. (582.67)	10047. (284.51)	7940. (224.82)	5845. (165.51)	3777. (106.96)	2780. (78.72)	1810. (51.26)	882. (24.98)	522. (14.77)

SUMMARY OF DAM SAFETY ANALYSIS

TWELVEMILE POND

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1180.90	1180.90	1181.50
STORAGE	82.	82.	195.
OUTFLOW	0.	0.	54.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1184.28	2.78	790.	2388.	34.00	43.00	0.00
.50	1183.11	1.61	526.	991.	27.50	43.50	0.00
.40	1182.82	1.32	464.	724.	26.00	43.75	0.00
.30	1182.49	.99	394.	466.	24.00	44.00	0.00
.20	1182.09	.59	311.	244.	20.00	44.75	0.00
.15	1181.85	.35	264.	156.	16.75	45.00	0.00
.10	1181.60	.10	214.	73.	9.50	46.00	0.00
.05	1181.29	0.00	155.	17.	0.00	48.25	0.00
.03	1181.14	0.00	126.	10.	0.00	48.25	0.00

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	2384.	1170.1	43.25
.50	989.	1168.3	43.75
.40	722.	1167.8	43.75
.30	465.	1167.2	44.25
.20	243.	1166.6	45.00
.15	156.	1166.2	45.25
.10	73.	1165.8	46.25
.05	17.	1165.2	48.75
.03	10.	1165.1	48.75

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	2355.	1000.1	43.50
.50	971.	999.2	44.25
.40	706.	999.0	44.50
.30	455.	998.7	45.00
.20	238.	998.3	45.75
.15	153.	998.1	46.25
.10	71.	997.8	47.50
.05	17.	997.4	51.25
.03	10.	997.3	51.00

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SUMMARY OF DAM SAFETY ANALYSIS

SAW CREEK CLUB DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	965.00	965.00	967.10
STORAGE	230.	230.	353.
OUTFLOW	0.	0.	1511.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	972.12	5.02	692.	20577.	25.50	43.75	0.00
.50	970.44	3.34	571.	10047.	19.00	43.75	0.00
.40	970.01	2.91	542.	7960.	17.25	43.75	0.00
.30	969.52	2.42	508.	5845.	14.75	44.00	0.00
.20	968.74	1.64	456.	3777.	11.00	44.25	0.00
.15	968.12	1.02	416.	2780.	8.50	44.25	0.00
.10	967.37	.27	369.	1810.	3.75	44.25	0.00
.05	966.47	0.00	314.	882.	0.00	44.50	0.00
.03	966.03	0.00	289.	522.	0.00	44.75	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 JAN 80
**********
    1          A1                        NATIONAL DAM INSPECTION PROGRAM
    2          A2                                SAW CREEK
    3          A3                           SAW CREEK CLUB DAM
    4          B     300        0        6        0        0        0        0        0       -4        0
    5          B1      5
    6          J       2        2        1
    7          J1     .5      .15
    8          K       0        1                                          1
    9          K1        RUNOFF INTO TWELVEMILE POND
   10          M       1        1     1.46                16                                  1
   11          P               22.0      106      118      128
   12          T                                                          1      .05                .2
   13          W    1.36      .45
   14          X    -1.5    -0.05      2.0
   15          K       1        1                                          1
   16          K1        ROUTE THROUGH TWELVEMILE POND
   17          Y                                 1        1
   18          Y1      1                                                -1180.9      -1
   19          Y41180.9   1181.3   1181.6   1182.3   1183.7   1185.1   1186.5
   20          Y5      0       17       73      285      925     1744     2788
   21          SA      0      187      544
   22          SE1179.4     1181     1200
   23          SS1180.9
   24          SD1181.5
   25          SL      0       38      109      125      125
   26          SY1181.5   1182.0   1182.7   1183.4     1200
   27          K       1        2                                          1
   28          K1        ROUTE TO SAW CREEK
   29          Y                                 1        1
   30          Y1      1                                                  -1
   31          Y6    .09      .07      .09     1165     1175     2200     .009
   32          Y7      0     1200      150     1180      300     1170      350     1165      400     1165
   33          Y7    650     1170     1150     1180     2300     1200
   34          K       1        3                                          1
   35          K1        ROUTE TO SAW CREEK CLUB DAM
   36          Y                                 1        1
   37          Y1      1                                                  -1
   38          Y6    .09      .07      .09      997     1007     6100     .013
   39          Y7      0     1060      110     1040      230     1020      650     1000      810      997
   40          Y7   1090     1000     1220     1020     1310     1040
   41          K       0        4                                          1
   42          K1        UNCONTROLLED RUNOFF INTO SAW CREEK CLUB DAM
   43          M       1        1    14.58                16.0                                  1
   44          P               22.0      106      118      128
   45          T                                                          1      .05
   46          W    3.05     0.45
   47          X    -1.5    -0.05      2.0
   48          K       2        4                                          1
   49          K1        COMBINE RUNOFF INTO SAW CREEK CLUB DAM
   50          K       1        4                                          1
```

Breach

D-16

```
51  K1      ROUTE THROUGH SAW CREEK CLUB DAM
52  Y                                   1       1
53  Y1    1                                                 -965       0
54  $A    0       56      98
55  $E  952.7     965     980
56  $$    965   150.5     3.3     1.5
57  $D  967.1
58  $L    1       15      19      40      75      128     295     615     650
59  $V  967.1   967.5   967.7     968   968.6   968.7   969.1   969.2     979
60  $B   80       1   952.7      .1     965   975.0
61  $R   80       1   952.7      .1     965   967.3
62  K     1       5                                           1
63  K1      ROUTE DOWNSTREAM
64  Y                                   1       1
65  Y1    1                                                   -1
66  Y6  .09     .07     .09     873     903    5700    .013
67  Y7    0     920     160     900     400     880     500     873     650     880
68  Y7  750     900     780     920     800     940
69  K     1       6                                           1
70  K1      X-SECT SAW CREEK ESTATES
71  Y                                   1       1
72  Y1    1                                                   -1
73  Y6  .09     .07     .09     798     820    6400    .011
74  Y7    0     840     120     820     270     800     274     798     356     798
75  Y7  360     800     760     820     980     840
76  K    99
```

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .15
HYDROGRAPH AT	1	1.46	1	1760.	528.
	(	3.78)	(	49.82)(	14.95)(
			2	1760.	528.
			(	49.82)(	14.95)(
ROUTED TO	1	1.46	1	954.	147.
	(	3.78)	(	27.02)(	4.15)(
			2	954.	147.
			(	27.02)(	4.15)(
ROUTED TO	2	1.46	1	953.	147.
	(	3.78)	(	26.99)(	4.15)(
			2	953.	147.
			(	26.99)(	4.15)(
ROUTED TO	3	1.46	1	933.	143.
	(	3.78)	(	26.43)(	4.05)(
			2	933.	143.
			(	26.43)(	4.05)(
HYDROGRAPH AT	4	14.58	1	9018.	2705.
	(	37.76)	(	255.36)(	76.61)(
			2	9018.	2705.
			(	255.36)(	76.61)(
2 COMBINED	4	16.04	1	9906.	2794.
	(	41.54)	(	280.51)(	79.11)(
			2	9906.	2794.
			(	280.51)(	79.11)(
ROUTED TO	4	16.04	1	9881.	2729.
	(	41.54)	(	279.80)(	77.28)(
			2	16108.	16072.
			(	456.12)(	455.10)(
ROUTED TO	5	16.04	1	9861.	2719.
	(	41.54)	(	279.22)(	76.99)(
			2	9913.	9866.
			(	280.77)(	279.37)(
ROUTED TO	6	16.04	1	9827.	2707.
	(	41.54)	(	278.28)(	76.66)(
			2	9758.	2669.

SUMMARY OF DAM SAFETY ANALYSIS

TWELVE MILE POND

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1180.90	1180.90	1181.50
STORAGE	82.	82.	195.
OUTFLOW	0.	0.	54.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1183.07	1.57	518.	954.	15.30	19.60	0.00
.15	1181.83	.33	259.	147.	12.60	21.10	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1180.90	1180.90	1181.50
STORAGE	82.	82.	195.
OUTFLOW	0.	0.	54.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1183.07	1.57	518.	954.	15.30	19.60	0.00
.15	1181.83	.33	259.	147.	12.60	21.10	0.00

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PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	953.	1168.2	19.70
.15	147.	1166.2	21.30

PLAN 2 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	953.	1166.2	19.70
.15	147.	1166.2	21.30

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	933.	999.2	20.20
.15	143.	998.1	22.40

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	933.	999.2	20.20
.15	143.	998.1	22.40

mmary of Dam Safety Analysis

SAN CREEK CLUB DAM

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	965.00	965.00	967.10
STORAGE	230.	230.	353.
OUTFLOW	0.	0.	1511.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	970.41	3.31	569.	9881.	12.20	19.70	0.00
.15	968.08	.98	414.	2729.	7.10	20.20	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	965.00	965.00	967.10
STORAGE	230.	230.	353.
OUTFLOW	0.	0.	1511.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	967.32	.22	366.	16108.	.38	15.30	15.20
.15	967.33	.23	367.	16072.	.48	17.90	17.80

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	9861.	881.8	19.80
.15	2719.	878.5	20.60

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	9913.	881.8	15.50
.15	9866.	881.8	18.10

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	9827.	806.8	20.10
.15	2707.	802.6	20.70

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	9758.	806.7	20.30
.15	7649.	805.8	18.40

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

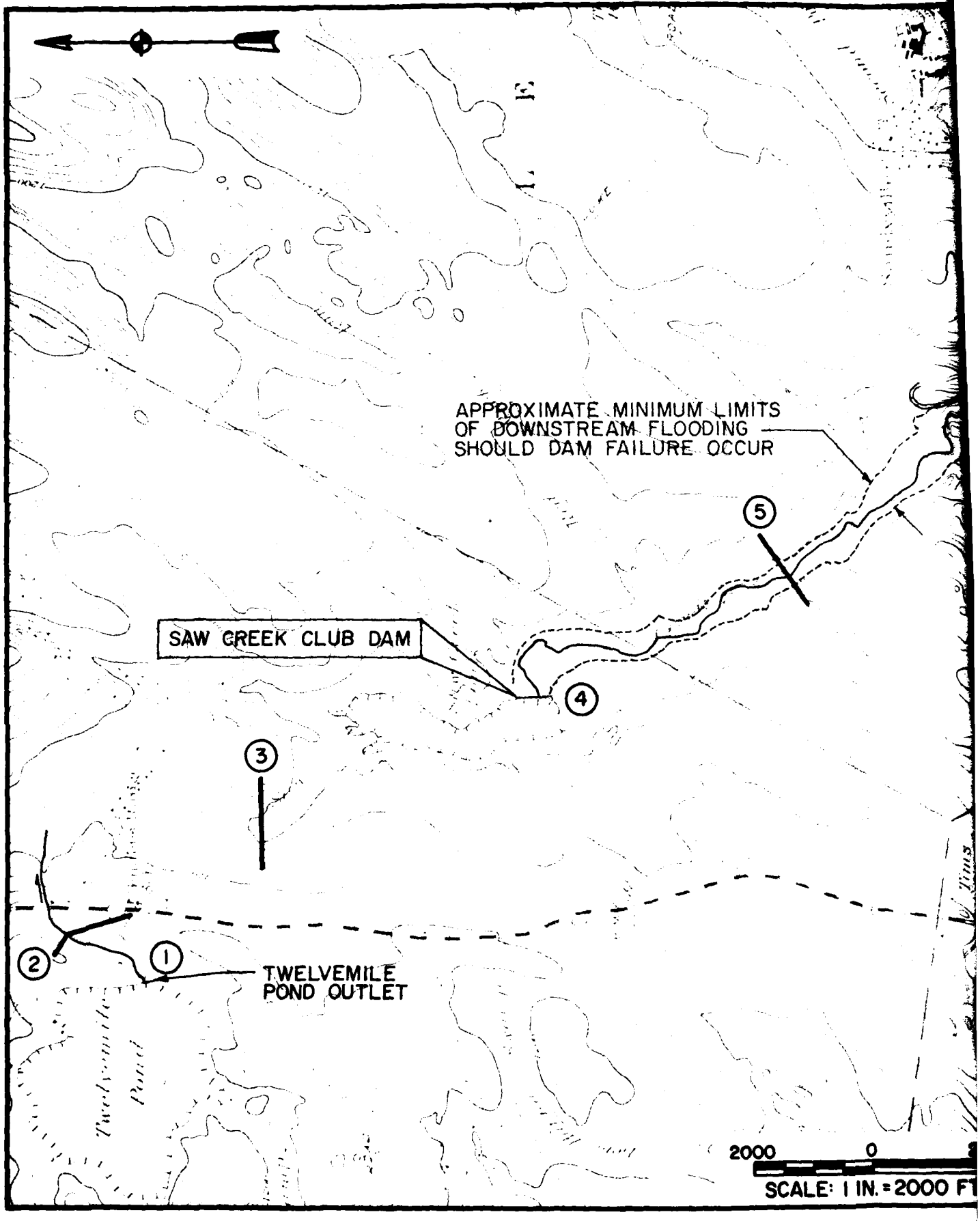
Summary of Pertinent Data

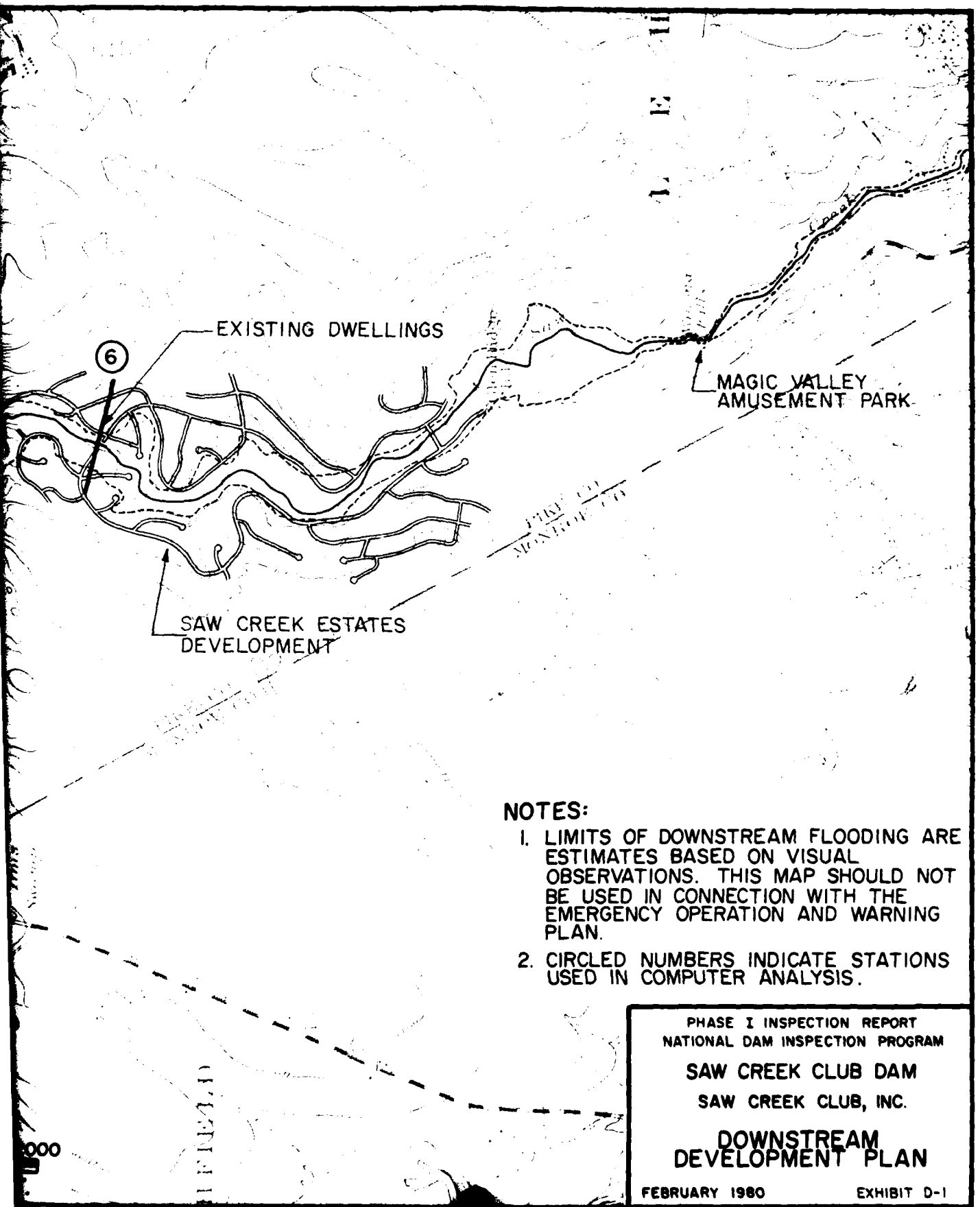
PMF RAINFALL = 24.59"

EXISTING CONDITIONS

	PMF	½ PMF	15% PMF
1. RUNOFF (INCHES)	22.24	11.12	3.37
2. PEAK INFLOW TO SAW CREEK CLUB DAM (CFS)	20,603	10,059	2,839
3. PEAK OUTFLOW FROM SAW CREEK CLUB DAM (ASSUMING NO FAILURE)	20,577	10,047	2,780
4. DEPTH OF OVERTOPPING (FT.)	5.02	3.34	1.02
5. OUTFLOW RESULTING FROM FAILURE (CFS)	N/A	16,108	16,072
6. NET DIFFERENCE IN PEAK WATER SURFACE ASSUMING FAILURE AND NO FAILURE (AT DAMAGE CENTER)	N/A	0'	3.2'

6818


APPROXIMATE MINIMUM LIMITS
OF DOWNSTREAM FLOODING
SHOULD DAM FAILURE OCCUR
SAW CREEK CLUB DAM
TWELVEMILE
POND OUTLET
1
2
3
4
5
2000
0
SCALE: 1 IN. = 2000 FT



NOTES:

1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATIONS. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SAW CREEK CLUB DAM

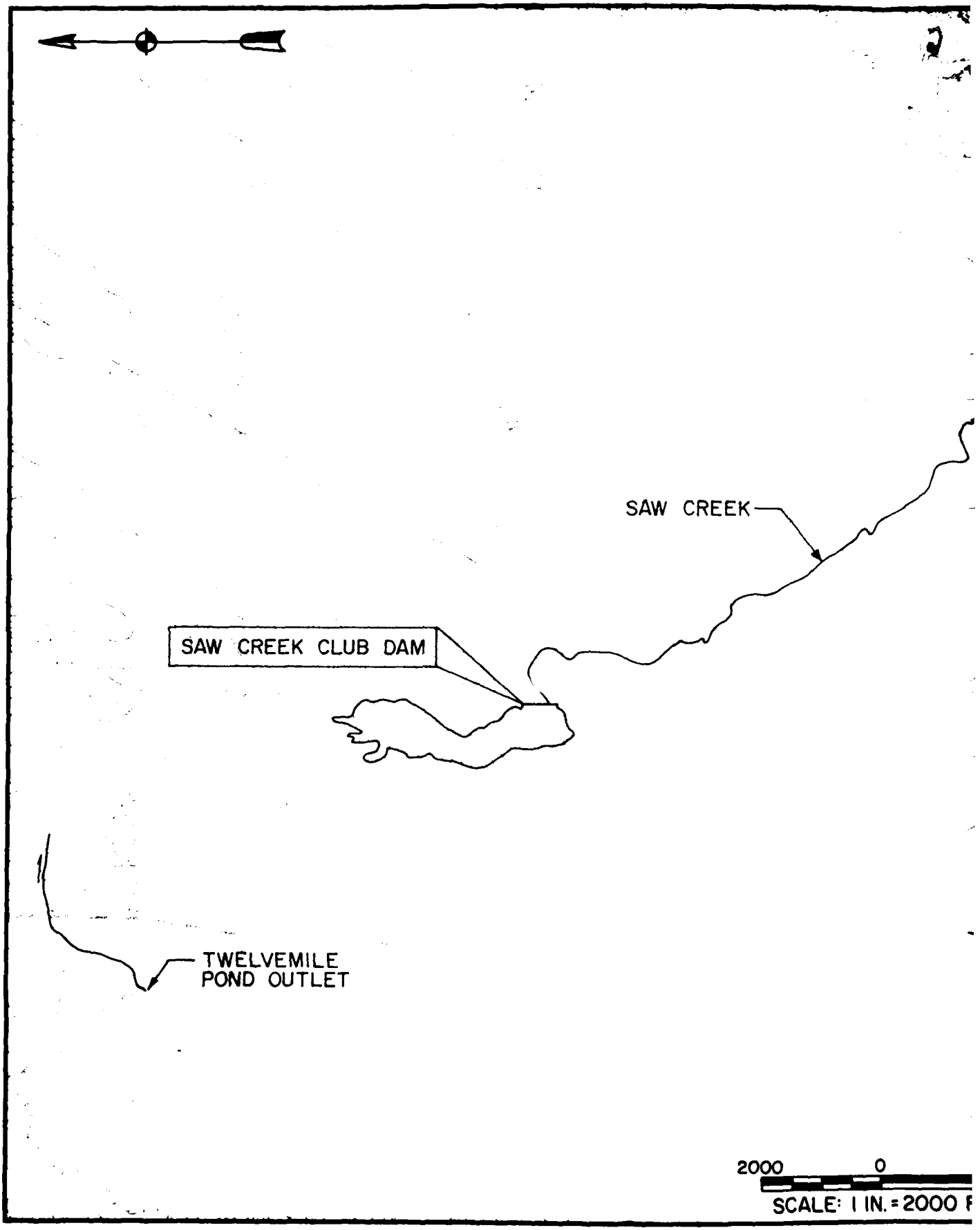
SAW CREEK CLUB, INC.

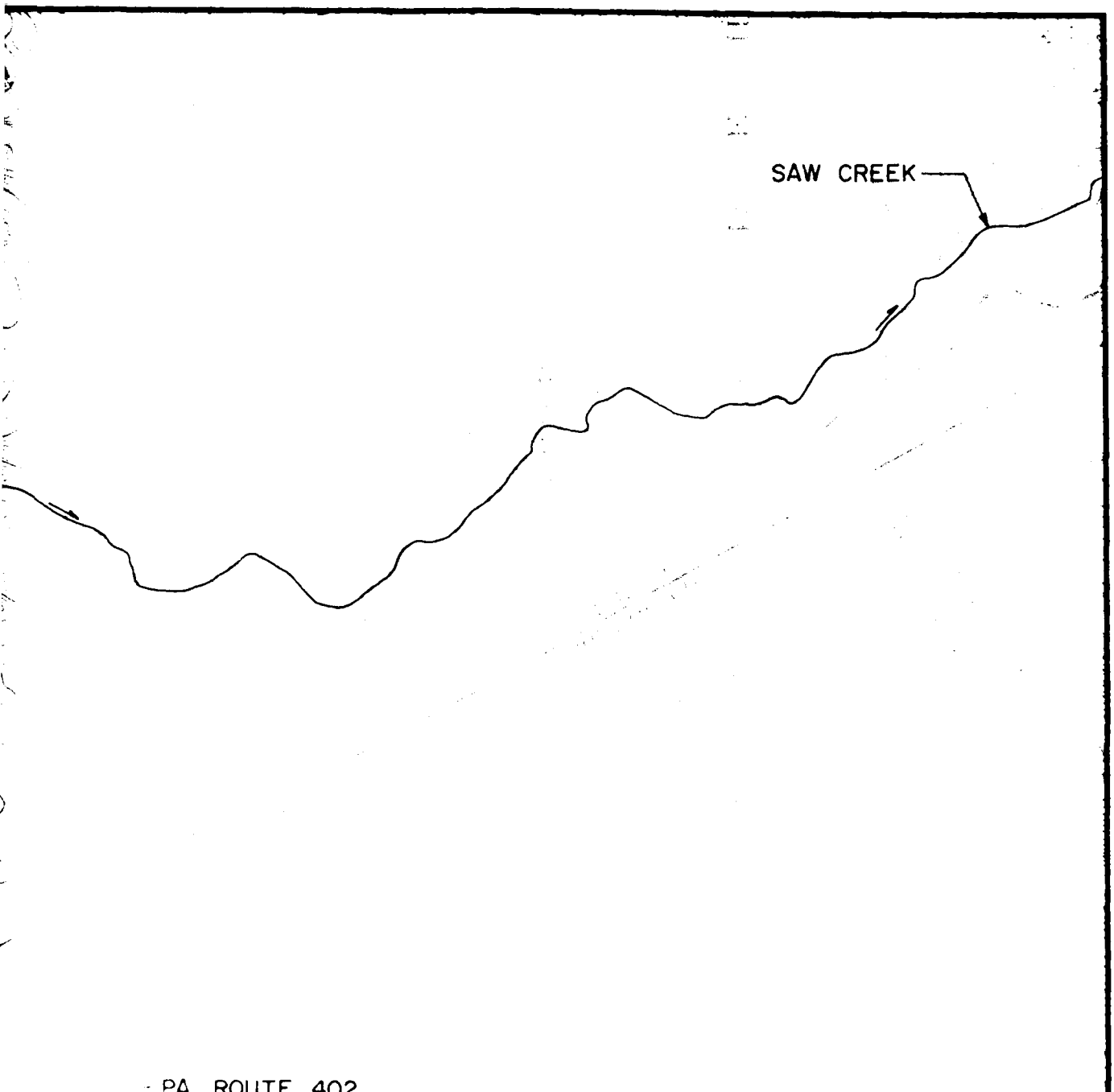
DOWNSTREAM DEVELOPMENT PLAN

FEBRUARY 1980 EXHIBIT D-1

APPENDIX E

PLATES


SAW CREEK
SAW CREEK CLUB DAM
TWELVEMILE
POND OUTLET
2000
0
SCALE: 1 IN. = 2000 F



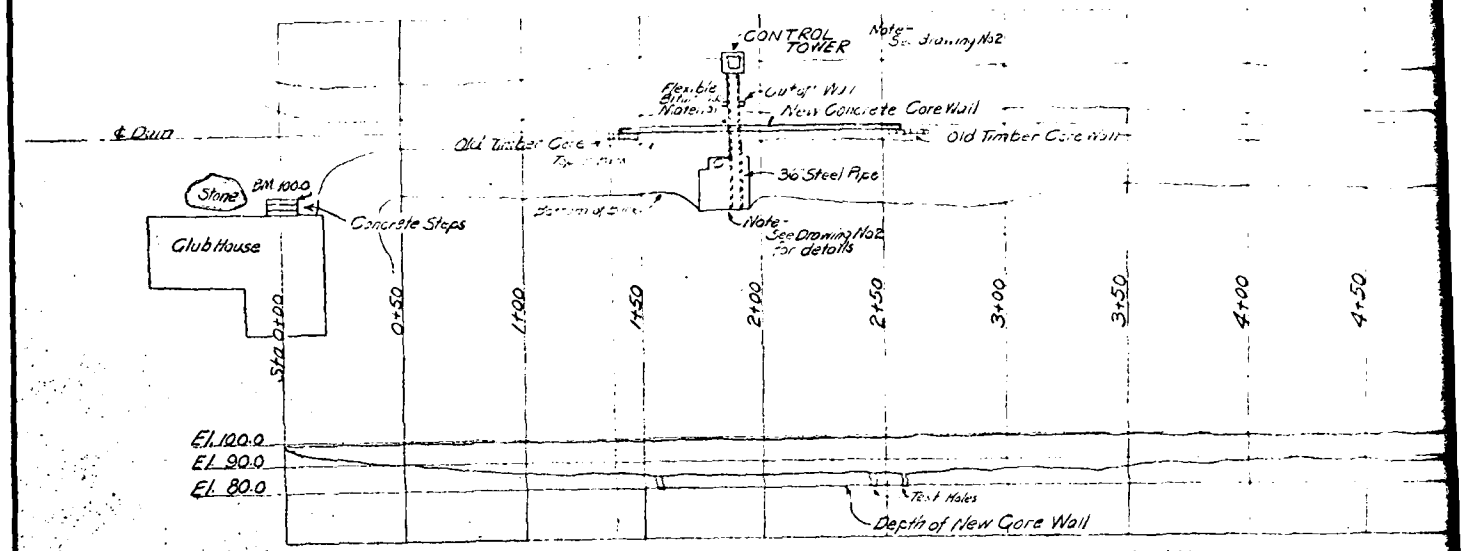
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SAW CREEK CLUB DAM

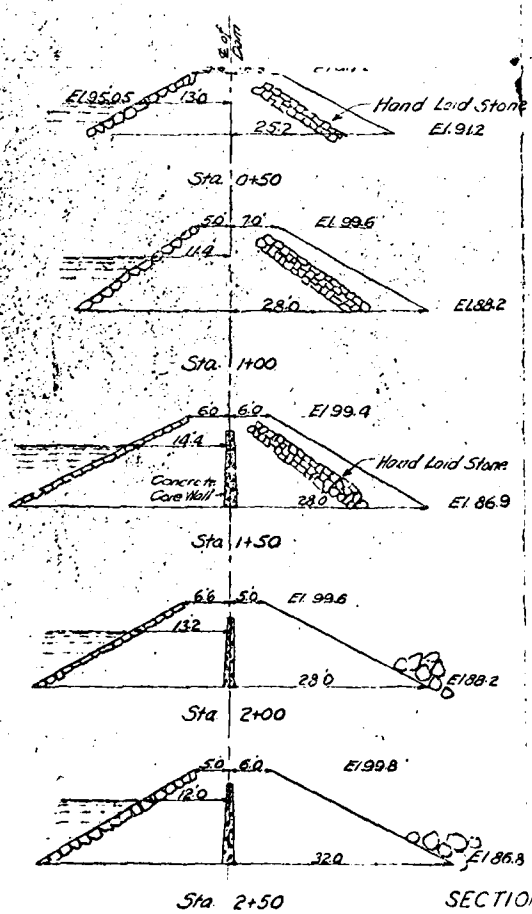
SAW CREEK CLUB, INC.

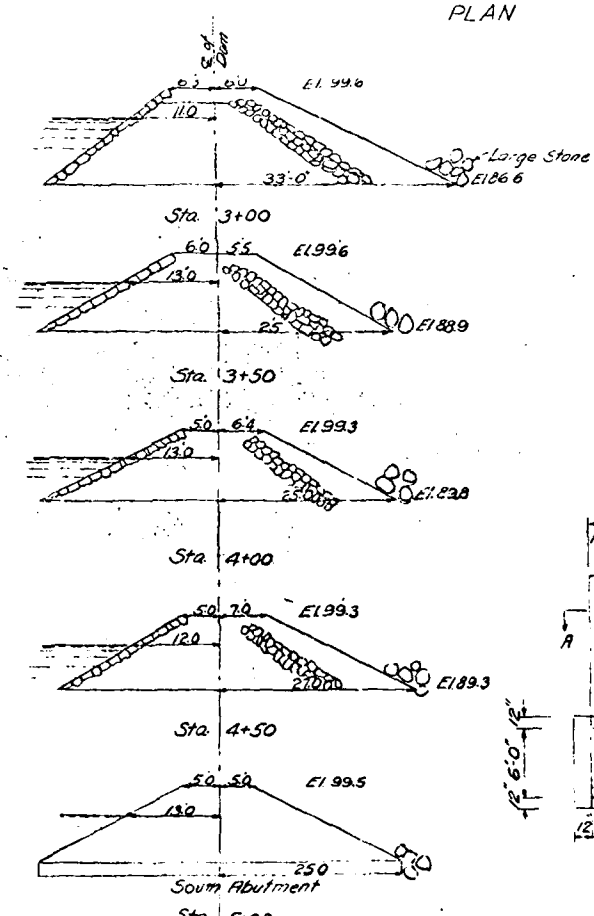
LOCATION MAP

FEBRUARY 1980 PLATE E-1

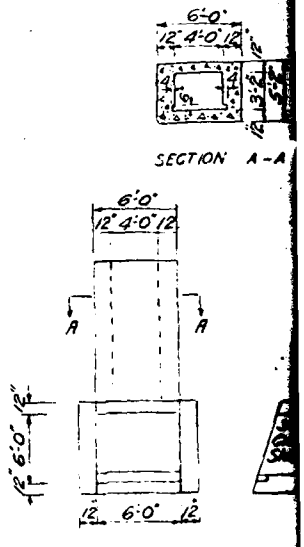


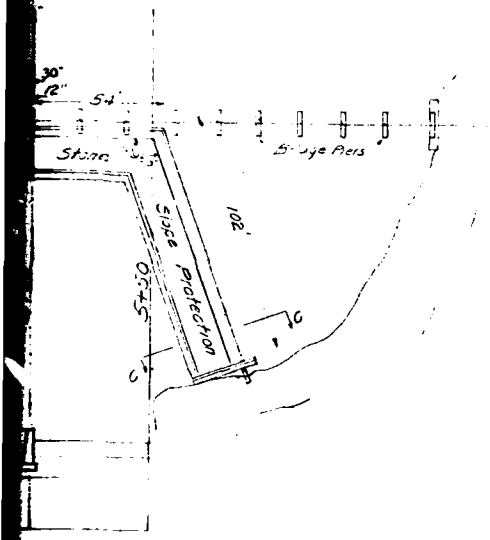
PLAN

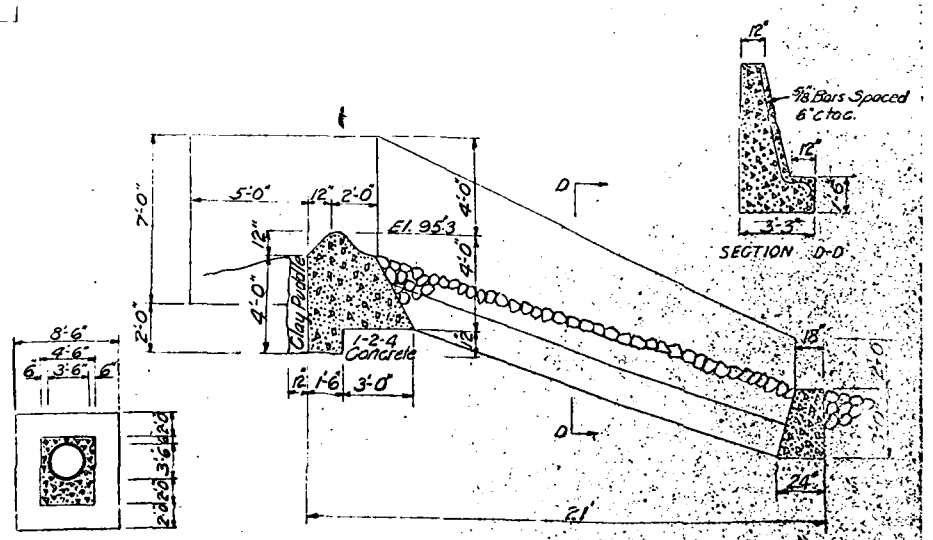




SECTIONS

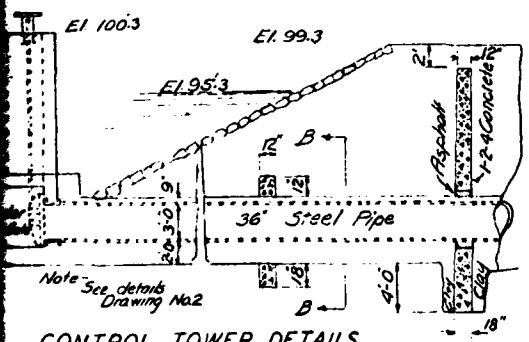






SECTION C-C
SCALE 1"=3'

SECTION D-D



CONTROL TOWER DETAILS
SCALE — 1"=6'

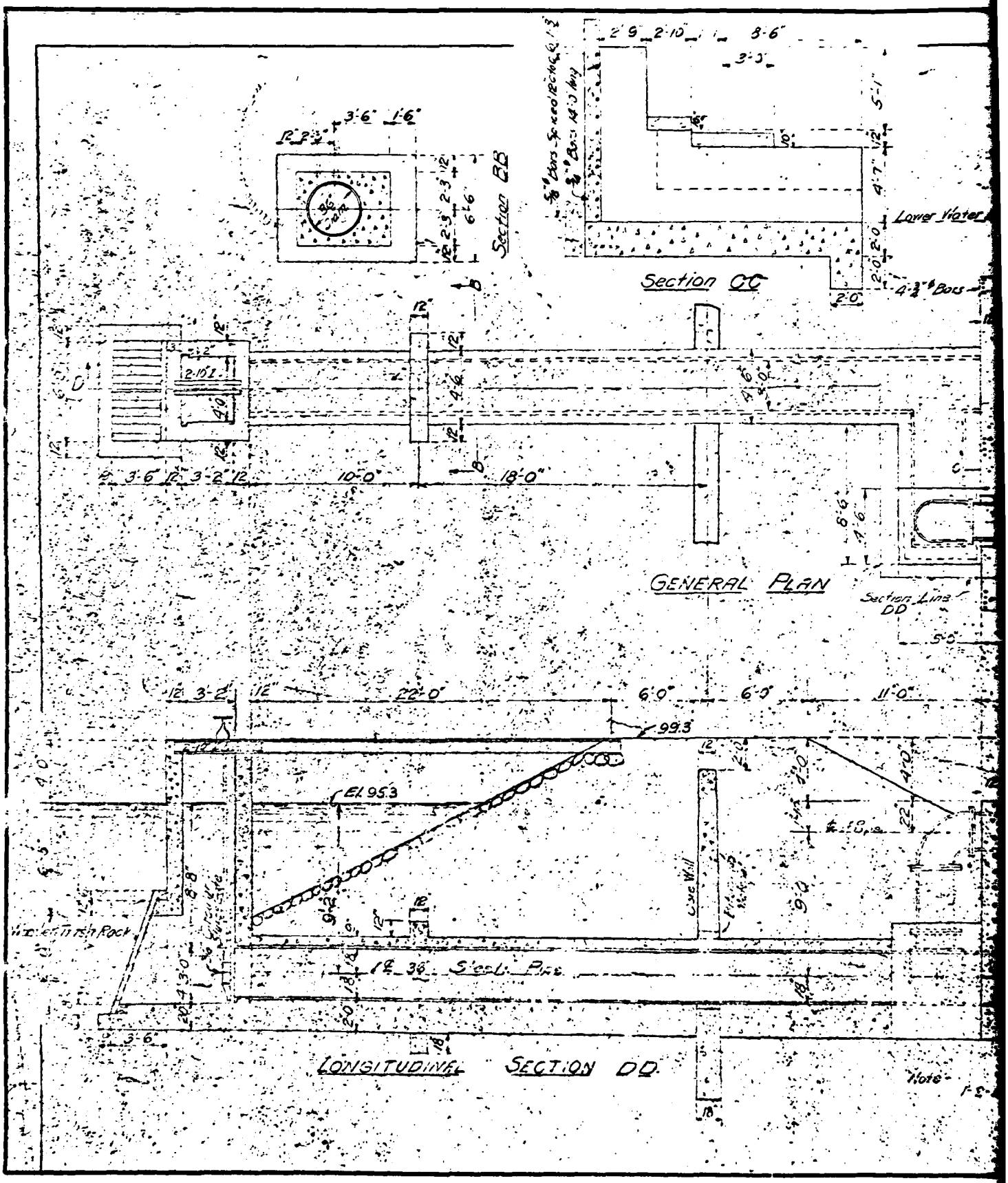
DAM
ACROSS
SAW CREEK
FOR
SAW CREEK HUNTING & FISHING ASSOCIATION
PIKE CO. PENNA.
SEPTEMBER 1931
E.H UHLER ENGR. BETHLEHEM PA.
DRAWING NO.3

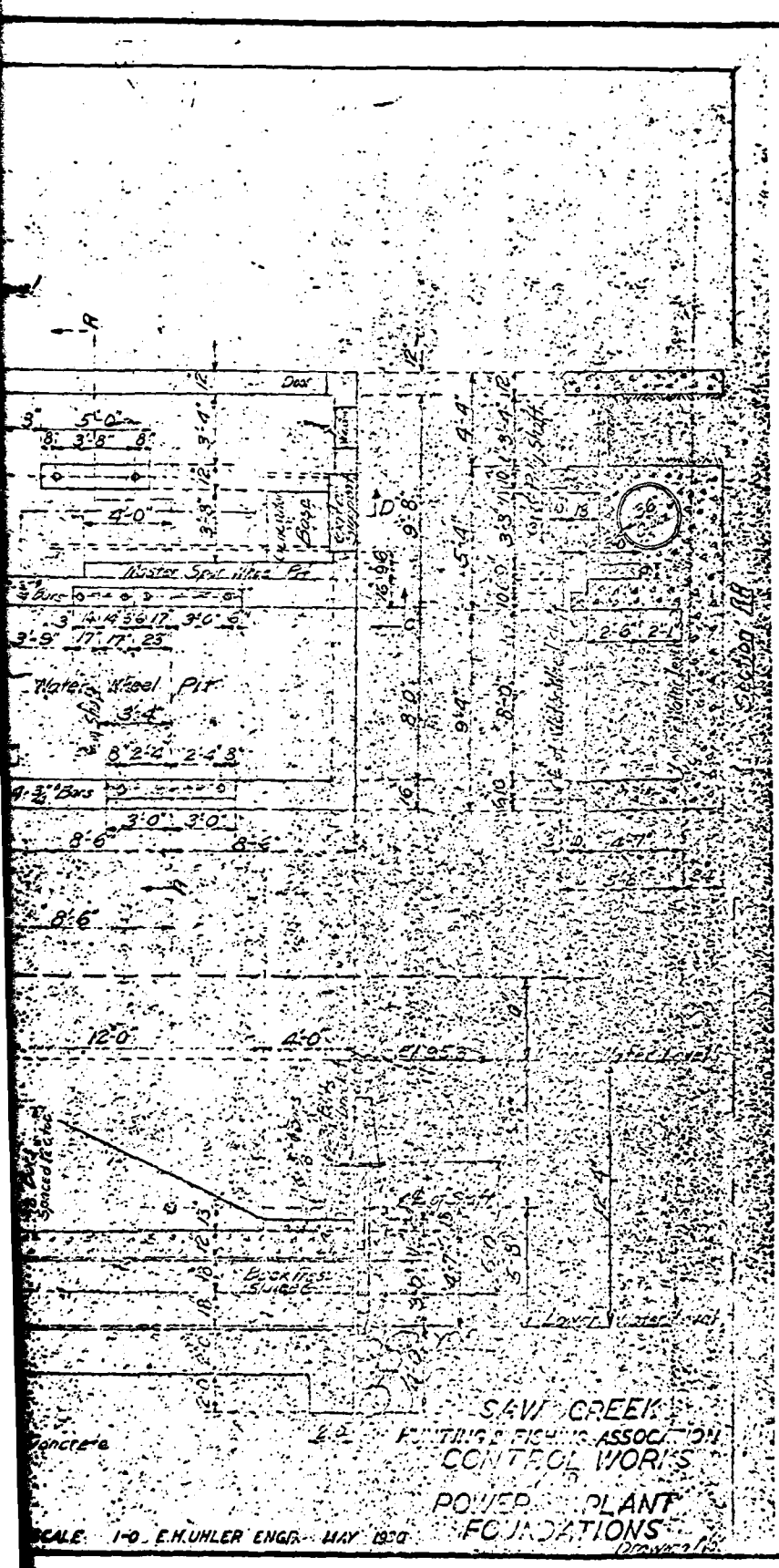
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SAW CREEK CLUB DAM
SAW CREEK CLUB, INC.

AS-BUILT DRAWING

FEBRUARY 1980 PLATE E-2


Section BB
Section CC
Lower Water
GENERAL PLAN
Section Line DD
LONGITUDINAL SECTION DD
El. 95.3
99.3
Steel Pile
Note



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SAW CREEK CLUB DAM
SAW CREEK CLUB, INC.

OUTLET WORKS

FEBRUARY 1980 PLATE E-3

APPENDIX F

GEOLOGY

SAW CREEK CLUB DAM

APPENDIX F

GEOLOGY

Saw Creek Club Dam is located in Pike County within the Appalachian Plateau Province. The most pronounced topographic feature in the area is Camelback Mountain, which is a part of the Pocono Plateau Escarpment. The escarpment is well-defined southwestward from Camelback Mountain, but is more irregular between Camelback and Mt. Pocono, which lies to the north. Streams east of the escarpment drain directly to the Delaware River, while those to the west drain to the Lehigh River.

The Pocono Plateau Section lies west of the escarpment. This area is relatively flat, with local relief seldom exceeding 100 feet. The topography has been greatly influenced by continental glaciation. Many features were created by deposition of glacial materials. The entire plateau lacks well-developed drainage.

East of the escarpment is the Glaciated Low Plateaus Section of the province. This area is characterized primarily by pre-glacial erosional topography with locally-thick glacial deposits. Local relief is generally 100 to 300 feet.

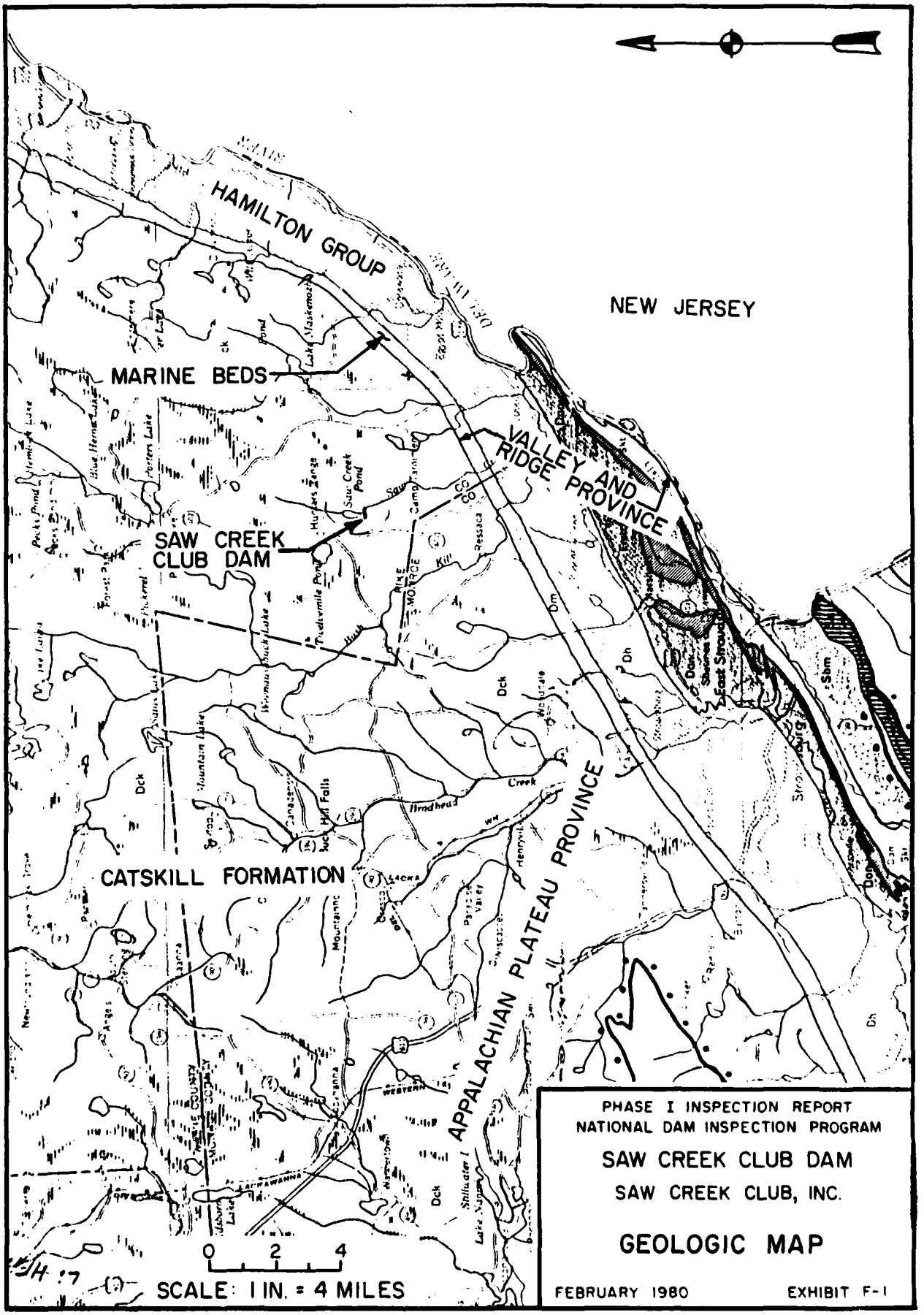
Bedrock units of the sections described above are the lithified sediments of offshore marine, marginal marine, deltaic and fluvial environments associated with the Devonian Period. These units include siltstones of the Mahantango Rock Formation, siltstones and shales of the Trimmers Rock Formation, and seven mapped members of the Catskill Formation. These members include sand-stones, siltstone, and shales of the Towamensing Member; sandstone, siltstone and shale of the Walcksville Member; sandstones, siltstones and shale of the Beaverdam Rum Member; sandstone and shale in the Long Run Member; sandstones and comglomerates in the Packerton Member; sandstone and some conglomerates in the Poplar Gap Member; and sandstones and conglomerates in the Duncannon Member.

Saw Creek Club Dam is underlain by the Walcksville Member of the Catskill Formation. The Walcksville Member is a cycle sequence of sandstones and shales with some

inter-bedded siltstones. Sandstones in this member are predominately medium-to thick-bedded, well-sorted quartz grains in a clay matrix with a silica cement. Within the sandstones there are a few interbedded shale chip conglomerates. Shales occur primarily as non-fissile to sub-fissile thin beds, with some grading into siltstone. All lithologies in this member exhibit low porosity except where fractured by cleavage and jointing.

Sandstones and siltstones associated with the Walcksville member maintain steep cut slopes. However, the shales weather rapidly when exposed. Slopes cut parallel to bedding strike may result in block slides on interbedded shales. The sandstones are good foundations for heavy structures.

Bedrock in the area is almost entirely overlain by glacial till of Late Wisconsin Age. This till is an unsorted mixture of clay, silt, sand, and gravel. It is moderately cohesive, and is generally derived locally from the sandstones of the Catskill Formation. Available information indicates that the dam is founded on a hard-compacted, sandy gravel, which is probably part of this till.


HAMILTON GROUP
NEW JERSEY
MARINE BEDS
VALLEY AND RIDGE PROVINCE
SAW CREEK CLUB DAM
CATSKILL FORMATION
APPALACHIAN PLATEAU PROVINCE
0 2 4
SCALE: 1 IN. = 4 MILES
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SAW CREEK CLUB DAM
SAW CREEK CLUB, INC.
GEOLOGIC MAP
FEBRUARY 1980
EXHIBIT F-1


FILMED